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With METALLURGICAL SUPPLEMENT.

# The Engineer.

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VOL. CLIV.—No. 3998] LONDON: FRIDAY EVENING, AUGUST 26, 1932 [PRICE {WITH SUPPLEMENT} ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES.

The Polytechnic, Regent STREET, W.1.
SCHOOL OF ENGINEERING.
President of the School: SIR JOHN THORNYCROFT, K.B.E., M. Inst. C.E., M.I.N.A.
Head of the School: PHILIP KEMP, M.Sc. Tech., M.I.E.E., A.I. Mech. E., Mem. A.I.E.E.
Head of Mechanical Engineering Dept.: R. F. THOMPSON, B.Sc. Hons. (Eng.), M.I. Mech. E., M.I. Mar. E.

The DAY DEPARTMENT RE-OPENS on SEPTEMBER 20th, 1932. ENTRANCE EXAMINATION COMMENCES SEPTEMBER 6th, at 10 a.m.
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SESSION 1932-33.
Vice-Chancellor: A. W. PICKARD-CAMBRIDGE, M.A., D.Litt.
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The LECTURE COURSES commence OCTOBER 5th, 1932.
The TECHNICAL LABORATORY COURSES commence SEPTEMBER 27th, 1932.
Particulars of Entrance and Research Scholarships available will be sent on application.
For further details of the Courses and for particulars of the Degrees, Associateships, Diplomas, and Certificates awarded on their successful completion, application should be made to
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Full particulars of courses and of the University Halls of Residence may be obtained on application to the REGISTRAR, M.V.T. College, Bristol.
The SESSION 1932-33 COMMENCES on OCTOBER 6th. 8891

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DEPARTMENTS OF CIVIL, MECHANICAL AND ELECTRICAL ENGINEERING.
Full particulars of these Courses will be forwarded on application to the REGISTRAR.
The SESSION COMMENCES on THURSDAY, OCTOBER 6th. 8867

University of Manchester.
PHYSICS DEPARTMENT.
Full particulars of the Lectures and Laboratory Courses in Physics, preparing for both the Ordinary and Honours Degrees, will be forwarded on application to the REGISTRAR.
The SESSION COMMENCES on THURSDAY, OCTOBER 6th. 8868

Northampton Polytechnic INSTITUTE,
ST. JOHN-STREET, LONDON, E.C.1.
APPLICATIONS are INVITED for the POST of CHIEF WORKSHOP INSTRUCTOR in the Mechanical Engineering Department.
Candidates must have had responsible experience of modern engineering production and be qualified to give practical and class instruction in general workshop processes and works organisation.
Present salary scale, £340-14-£480, less 10 per cent. Conditions of appointment will be sent on request.
Applications should be received by September 15th.
S. C. LAWS, M.A., M.Sc.,
8883 Principal.

## The Engineer

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PUBLIC NOTICES.

PATENTS AND DESIGNS ACTS, 1907 TO 1928.
Notice is Hereby Given that INTERNATIONAL MINING MACHINERY CORPORATION, a Corporation of the State of Delaware, of No. 927, Market-street, Wilmington, Delaware, United States of America, SEEK LEAVE to AMEND the SPECIFICATION of LETTERS PATENT No. 223,279 granted to Rembrandt Peale, Richard Peale, and Rembrandt, Jnr., for an invention entitled "Process and Apparatus for Separating Intermixed Divided Materials of Different Specific Gravities."
Particulars of the proposed Amendment were set forth in No. 2274 of the Official Journal (Patents), published on August 17th, 1932.
Any person, or persons, may give Notice of Opposition to the Amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C.2, within one calendar month from the date of publication of the said Journal.
W. S. JARRATT,
8889 Comptroller-General.

Metropolitan Water Board.
TENDERS FOR THE SUPPLY OF CAST IRON STRAIGHT PIPES.
The Metropolitan Water Board invite TENDERS for the SUPPLY of CAST IRON and SPUN IRON SOCKET and SPIGOT STRAIGHT PIPES for the periods of six and twelve months, commencing 1st October, 1932.
Tenders must be submitted on the official forms (Tender No. 3), which may be obtained on and after Monday, 29th August, 1932, from the Chief Engineer, by personal application at the offices of the Board (Room 155), or upon forwarding a stamped addressed sack envelope (14in. by 9in.).
Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board, and endorsed "Tender for Cast Iron Pipes," must be delivered at the offices of the Board (Room 122) not later than 11 a.m. on Tuesday, 13th September, 1932.
The Board do not bind themselves to accept the lowest or any Tender.
G. F. STRINGER,
Clerk of the Board.
Offices of the Board,
173, Rosebery-avenue, E.C.1.
18th August, 1932. 8900

PUBLIC NOTICES.

City of Nottingham.
TO CONTRACTORS.
MAIN DRAINAGE.—CONTRACT NO. 6.
GRAVITATION TRUNK SEWER (SECOND SECTION).
The General Works and Highways Committee is prepared to receive TENDERS for the CONSTRUCTION of about ¾ MILES, mostly in tunnel, of BRICK SEWERS, varying from 8ft. 6in. to 7ft. in diameter, together with various CHAMBERS and other appurtenant WORKS.
TENDERS WILL BE CONSIDERED ONLY FROM CONTRACTORS WHO HAVE HAD CONSIDERABLE EXPERIENCE IN CARRYING OUT LARGE WORKS OF A SIMILAR NATURE.
Drawings may be seen, and copies of the general conditions of contract, specification, bill of quantities, and form of Tender may be obtained on application to Mr. T. Wallis Gordon, City Engineer and Surveyor, Guildhall, Nottingham, on payment of a deposit of Five Pounds, which will be returned on receipt of a bona fide Tender.
Sealed Tenders, in the official envelope provided, are to be delivered to the undersigned not later than 6 p.m. on Thursday, 22nd September, 1932.
The lowest or any Tender will not necessarily be accepted and Tenders will only be accepted from contractors who conform to the conditions of contract as regards paying the local standard rate of wages, &c., and to the working rules of the Nottingham district.
By Order,
W. J. BOARD,
Town Clerk.
Guildhall, Nottingham,
August, 1932. 8890

The Civil Engineers Appointments BOARD, 8, Princes-street, Westminster, S.W.1, acting under annual licence from the London County Council, invites INQUIRIES from EMPLOYERS SEEKING the SERVICES of PROFESSIONAL ENGINEERS, either as Assistants or in more responsible positions.
All those whose names are accepted for entry in the Board's Register for employment possess qualifications which have been attested by means of scientific examinations, practical training, and experience.
P2183

PUBLIC NOTICES.

Borough of Ilford & Borough OF BARKING.
ILFORD AND BARKING JOINT SEWERAGE COMMITTEE.
DIESEL ENGINE AND ELECTRIC GENERATING HOUSE.
CONTRACT NO. 8A.
The above Authorities are prepared to receive TENDERS for the CONSTRUCTION of an ENGINE-HOUSE to house Diesel Engine Electric Generating Sets and Switchboard and appurtenant Works at Barking.
Plans may be seen and general conditions of contract, specification, quantities, and form of Tender may be obtained at the offices of the Engineers, Messrs. W. H. Radford and Son, Albion Chambers, King-street, Nottingham, on deposit of Three Guineas (cheque), which will be returned on receipt of a bona fide Tender and the return of the quantities.
Plans may also be seen at the Town Hall, Barking, or the Town Hall, Ilford.
The lowest or any Tender will not necessarily be accepted.
Sealed Tenders to be delivered to the undersigned on or before the first post on Monday, 19th September, 1932, endorsed "Diesel Engine-house."
By Order of the Joint Committee of the above Authorities.
ADAM PARTINGTON,
Clerk to the Joint Committee.
Town Hall, Ilford,
23rd August, 1932. 8896

Borough of Shrewsbury.
SHREWSBURY CORPORATION (WATER) SCHEME, 1932.
CONTRACT No. 3.
The Corporation are prepared to receive TENDERS from Contractors experienced in Waterworks Construction for the undermentioned WORKS to be carried out in the Parish of Bicton and the Borough of Shrewsbury in the County of Salop:—
River Severn Intake with Pump-house in connection therewith.
Reinforced Concrete Storage Reservoir (4,000,000 gallons), with Chemical House in connection therewith.
Reinforced Concrete Elevated Water Tower (500,000 gallons); Precipitation Tanks; Filters; Filter house; Engine-house; Pure Water Reservoir; Sludge Disposal Works, and Foreman's House.
Cast Iron Pumping and Supply Mains (laying only), including duplicate C.I. Syphon under the River Severn.
Together with other Works in connection therewith.
Plans can be inspected and conditions of contract and quantity specification obtained upon application to Messrs. Fred. J. and Edw. Wilson Dixon, MM. Inst. C.E., Engineers, and Mr. W. Arnold Hewitt, M. Inst. W.E., Borough Water Engineer, at the Engineer's Office, Guildhall, Shrewsbury, upon payment of cheque for £10 (made payable to "Borough of Shrewsbury"), returnable on receipt of a bona fide Tender, fully priced out on the forms supplied.
Sealed Tenders to be sent in addressed to the undersigned and endorsed "Shrewsbury Water," not later than 10 a.m., October 1st, 1932.
The Corporation do not bind themselves to accept the lowest or any Tender.
The contract conditions contain a clause for the employment of not less than 80 per cent. of local unemployed labour.
R. F. PRIDEAUX,
Town Clerk.
Guildhall, Shrewsbury,
24th August, 1932. 8905

London County Council.
TENDERS are INVITED for CLEANING, REPAINTING, &c., at Victoria, Albert, Chelsea and Grosvenor-road embankments, and certain Dock Bridges.
Specification, form of Tender, &c., may be obtained on application to the Chief Engineer upon payment of £1 by crossed cheque or order payable to the London County Council. (NOTE.—Cash will NOT be accepted.) This amount will be returnable only if a BONA FIDE Tender has been sent in and not subsequently withdrawn. Full particulars of the work may be obtained on personal application and the contract documents may be inspected before payment of the fee.
Remittances by post should be addressed to the Chief Engineer (A), The Old County Hall, Spring-gardens, S.W.1. Personal inquiries at Room 2, No. 3, Warwick House-street, Cockspur-street, S.W.1.
The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract and in THE LONDON COUNTY COUNCIL GAZETTE.
No Tender received by the CLERK OF THE COUNCIL at the County Hall, Westminster Bridge, S.E.1, after 4 p.m., on Monday, 12th September, 1932, will be considered.
The Council does not bind itself to accept the LOWEST or any Tender. 8903

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# The Engineer

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*** READING CASES, *to hold two copies of* THE ENGINEER, *cloth sides and leather backs, can now be supplied at 4s. 9d. each, 5s. 3d. post free.*


### "THE METALLURGIST."

This Supplement, which deals with the Science and Practice of Metallurgy, both ferrous and non-ferrous, is published free with the last issue of THE ENGINEER in each calendar month.

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*Letters relating to the Advertisement and the Publishing Department of the Paper are to be addressed to the Publisher, all other letters are to be addressed to the Editor of* THE ENGINEER.

### THE ENGINEER DIRECTORY.

This Directory, which is published annually in the interests of advertisers in THE ENGINEER, may be obtained free of charge on application to the Publisher.

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# A Seven-Day Journal

## Developments in Autogiro Design.

IT has been revealed during the past week that interesting developments are taking place in the design of the Cierva autogiro, and experimental work is now being carried out with the object of producing an altered type. It is hoped, and experiment has shown that it is possible, that the small wings and ailerons fitted to the autogiros at present in use may be dispensed with in the new type, a system of direct control from the rotor itself being substituted. According to present plans, the new machine will be a single-seater, about 15ft. long, with rotor blades having a span of 24ft. It is proposed that the blades shall fold back so that the complete autogiro could be stored in a small garage. The machine is to be fitted with a motor-cycle engine of small power, which will give it an air speed in the neighbourhood of 80 m.p.h. Owing to the alterations in the design and the comparative facility with which a machine without fixed wings can be made, it is believed that the price of the new pattern will be little more than that of a moderately costly car. In any case it will be very considerably less than that of the present type of autogiro.

## Rail and Road in the Argentine.

BECAUSE competition of road organisations has very seriously affected in recent years the earnings of the railways, a Bill has been submitted to Congress by the Argentine Government to regulate road transport in the Argentine. The terms of the Bill are somewhat drastic in character. All concessions for road transport services are to be nationalised, and in future a service will only be allowed to come into operation after proof has been shown that it is necessary and that it avoids ruinous competition with the railways. Rates and routes and the regulation of the speed of the road services are to be put under the control of the Director-General of Railways. Road transport organisations will be compelled to place their employees on the same basis as railway workers, and it is stated that the proceeds of the taxation of road vehicles will be used principally for the purpose of building roads converging on railway stations and ports. The need for some kind of regulation is demonstrated by the figures of railway receipts, which have shown a decline of about 10 per cent. compared to those of last year. Part of this fall is accounted for by the reduction in the number of passengers carried. The railways complain that the low fares of the omnibuses attract passengers in ever-increasing numbers.

## The Scrapping of Obsolete Ships.

THE latest returns of the laid-up shipping throughout the world show a further general increase of 1,000,000 gross tons during last month, the aggregate laid-up tonnage now standing at approximately 14,115,000 tons, or close upon one-fifth of the world mercantile marine. Much of this tonnage is admittedly obsolete, and steps in the direction of scrapping some of it have already been taken in Germany, while the French Chamber of Shipping is now considering a similar project. Within the last few days a British scheme for the scrapping of obsolete tramp tonnage has been elaborated by Lieut.-Colonel Frank Pickersgill and Mr. W. S. Martin, of Wm. Pickersgill and Sons, Ltd., shipbuilders, of Sunderland. It is suggested that all British owners of tramp tonnage should be invited by the Chamber of Shipping to collaborate in the scheme and contribute to a mutual pool, the purpose of which would be to provide funds for the withdrawal of a fixed amount of tonnage twenty years old and over from the market annually, much in the same manner as the shipbuilders have done in combining together to close redundant shipbuilding yards. The general lines of the scheme have been worked out, and although it has been criticised by some shipowners, it has, we understand, received the approval of several of the leading shipping firms. The help of the Government, both in assisting to create the fund and in making income tax allowances for such payments and equitable depreciation charges on ships, is also suggested in the report on the scheme.

## Industries of the North-East Coast Area.

THE report of Professor H. M. Hallsworth, the head of the Department of Economics at Armstrong College, Newcastle-upon-Tyne, on the industrial survey of the North-East Coast Area, which he has undertaken for the Board of Trade, and which was published at the end of last week, is not optimistic as to the future of the North-East Coast industry, at least, under present conditions. The area, Professor Hallsworth states, is likely to play a less important part in the national economy than it has done in the past. During the war years the capacity of its industries was increased beyond the requirements of the present time, and the time now seems ripe for smaller and more compact industries. In agriculture, as in industry, what is needed, the report says, is the willingness and ability to appreciate new ideas, to adopt new methods, and to test new enterprises. The varied industries, mining, shipbuilding, engineering, and chemical manufacture, among others, are all dealt with in a 500-page report, which, while critical, nevertheless indicates ways of improvement. Professor Hallsworth points out that even in a boom year industry from, say, 1932 to 1936, could not accommodate the 712,000 persons insured in 1931, but only about 622,000 of them. Besides new industries a greater development of the natural resources of the area is called for. The report is one which is worthy of the careful attention of all who are interested in the future of the area under survey.

## The American Liner Manhattan.

THE new United States Lines' cabin-class liner "Manhattan," which has been built and engined by the New York Shipbuilding Company, of Camden, New Jersey, left New York on Wednesday, August 10th, and completed a successful maiden voyage eastward by arriving at Hamburg on Friday last, August 19th. According to schedule, she called at Cork, Plymouth, and Le Havre, on her sixth and seventh days out from New York. Like her sister ship "Washington," which is now under construction, she has a length of 705ft., a beam of 86ft., and a moulded depth of 47ft. Her gross measurement is 24,289 tons, and she carries 400 cabin, 500 tourist, and 200 third-class passengers. Her stability has been very carefully considered, and her positive metacentric heights in the light and fully loaded conditions are given as 6in. and 4·4ft. respectively. The passenger accommodation throughout the ship accords with the highest modern standards, and the watertight subdivision of the hull and other safety precautions conform with the latest international requirements. The propelling machinery comprises a twin-screw arrangement of single-reduction geared turbines of the Parsons type, which have a designed overload output of 34,500 S.H.P., and a normal continuous output of 30,000 S.H.P., the corresponding ship speeds being 22 and 20 knots. Steam is raised in six Babcock and Wilcox express type water-tube boilers, designed for a working pressure of 400 lb. per square inch, with a full power superheated steam temperature of 682 deg. Fah. On trial a fuel consumption of 0·597 was obtained, which it is expected will be bettered under service conditions.

## Oil Prospecting by Aerial Survey.

AN important development in the search for oil in Australia has been begun with the departure from Queensland of a Royal Australian Air Force Survey Squadron for Darwin, in the Northern Territory. The flight, which has been arranged by the Minister for Defence, Sir George Pearce, and the Commonwealth Geological Adviser, Dr. W. G. Woolnough, has as its immediate object the testing of the value to Australia of the aerial photographic survey method of oil prospecting which has been used with success in America. A preliminary flight in which the method it is proposed to use was successfully tested took place at Longreach, Queensland, in January last. The first base of the present expedition, which will include two aeroplanes, will be at Darwin, but photographic work will also be done in the flight across Queensland. On completion of the investigations around the Darwin base, the expedition will move on to the Fitzroy Crossing, in Western Australia, with its base at Broome. Exmouth Gulf, using Onslow as a base, will next be investigated, after which the expedition will move to the Woorramel district, south-east of Carnavon in Western Australia. After making observations on the Nullarbor Plain, both south and north of the Transcontinental Railway, the work of the survey will conclude with an examination of the coast line from Adelaide to Melbourne. It is hoped that as a result of the survey it will be possible in the near future to arrange an oil-drilling programme.

## Another L.M.S. Railway Bridge Replacement.

IN our issue of July 22nd, we recorded the speedy erection of a new railway bridge at Pictor, near Buxton, where the river Wye and the main road running side by side are crossed by the railway line to Sheffield and Derby. This bridge is one of four which are to be replaced by Dorman, Long and Co., Ltd., within the next few months, all of them in the Peak District. The second bridge was successfully hauled into place on Sunday last, August 21st. Like the others, it is 160ft. long, weighs 700 tons, and is built entirely of British steel. It carries the railway line from Buxton to Sheffield and Derby, its double span crossing the river Wye and the main road from Buxton to Bakewell. It takes the place of an old wrought iron bridge, which was considered inadequate to the needs of modern heavy railway traffic. The old bridge was demolished within the space of five hours on Sunday, and immediately the new bridge, which had been constructed on large trestles alongside, was drawn into position by four hawsers, each of which was wound on a winch turned by four men. In spite of continual rain this part of the task was accomplished in an hour, which was well ahead of the scheduled time. Friction was minimised by large ball bearings placed between the trestles and the runners supporting the bridge. The work of relaying the metals followed, and the line was reopened during the afternoon. The further two bridge replacements are scheduled to take place in October and November, thus completing a £33,000 contract.

## The Shannon Power Plant.

IN our issues of March 23rd and 30th, 1928, we described the three water turbines and generators of the Shannon power plant. The order for the fourth set has now been placed with Siemens, Schuckert and Co., of Berlin, who, as main contractors, will carry out the constructional and electrical parts of the contract, the supplying of the water turbine itself being entrusted to J. M. Voith, of Heidenheim, Germany. Whereas the three existing machines are all of the Francis high-speed type, the new unit, as it is desired to use it for load regulation purposes, will be of the Kaplan type. It will have a maximum designed output of 38,600 H.P. when operating at the final head of 106ft., but for the present it will operate at 95ft. maximum head, corresponding to an output of 30,000 H.P. It is of interest to mention that while in point of size the new unit is equalled or exceeded by other Kaplan units, it is outstanding in its high operating head, which is the largest for which a Kaplan turbine has yet been designed, being over 30ft. higher than in any existing turbine of the type. In 1922 it was considered impossible to increase the range of the Kaplan turbine beyond 26ft. head, but in the last ten years advances in design have now made possible the 106ft. head turbine ordered for the Shannon scheme. Under this high head the diameter of the runner will be relatively small, approximately only 5·5 m., with a higher specific blade loading and with shorter blades. For this reason from six to seven blades will be adopted, and they will be made of stainless steel with a 13 per cent. chromium content.

## The "Back to Coal" Movement.

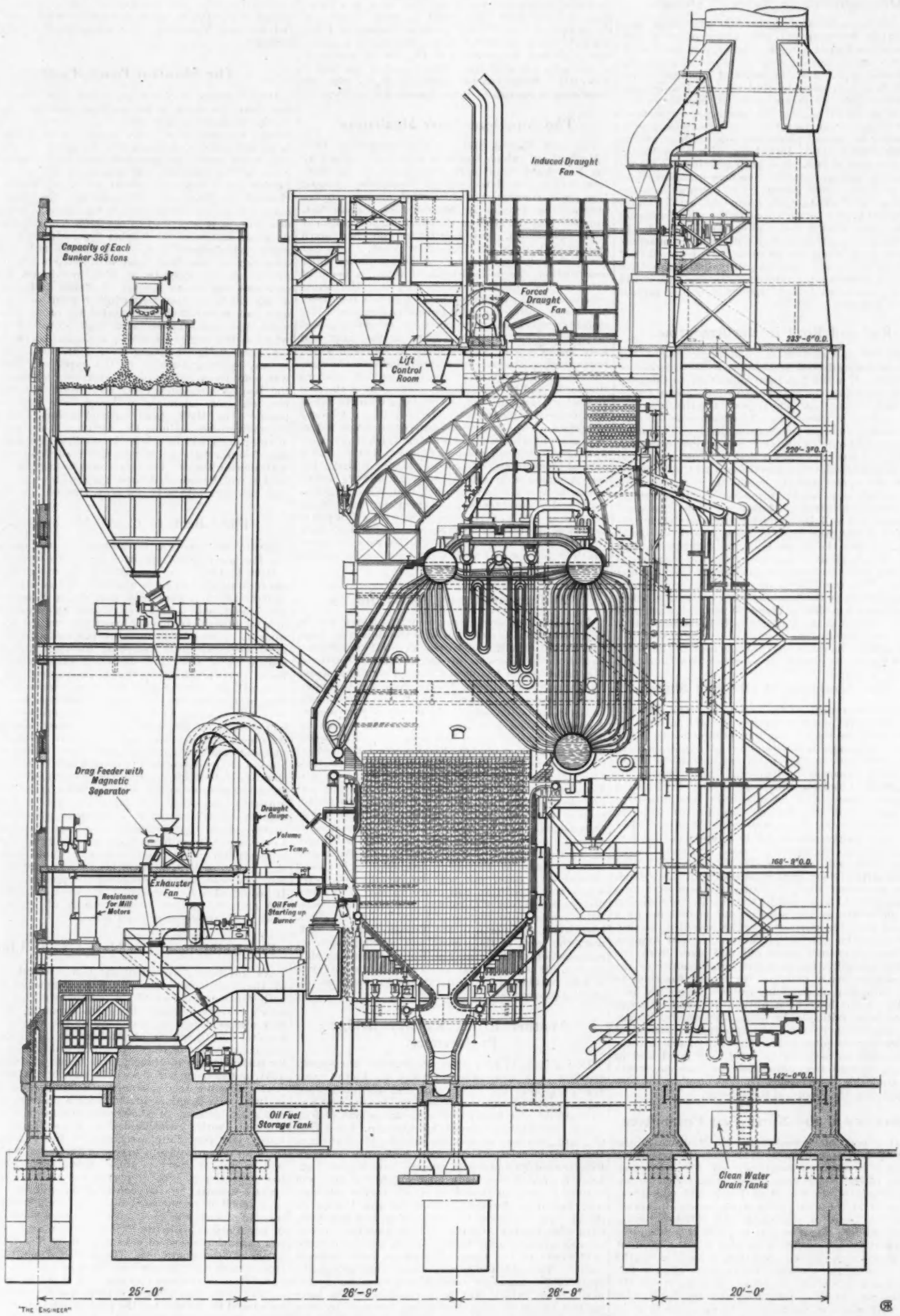
EARLY next month, we understand, the scope of the Parliamentary Committee set up to further the "Back to Coal" movement is to be extended. It has been decided to invite a number of coal utilisation experts to co-operate with the Welsh Members of Parliament, with a view to exploring the possibilities of coal utilisation, having particular regard to the work at present being done by the various Government Departments. Following his own suggestion that work of this kind should be undertaken, Mr. Foot, the Minister for Mines, has agreed to the proposal, and early results are to be expected. The lines of investigation to be pursued will not, however, be confined alone to Government experiments, but will include all individual research work having as its object the development of modern methods of utilising coal instead of oil fuel. One of the main objects of the extended Committee will be to ensure that the fullest information will be available, with the least possible delay, covering all new ideas and apparatus concerned with the use of coal in such a manner as will enable it to compete with oil. It is pointed out that a change over from imported oil to the supply from home resources of all fuel and oil required for power and transport would increase the output of British coalfields by some 30 million tons per year, thereby doubling the present output. It would also be responsible for creating between 150 and 200 million pounds worth of productive work in the provision of plant alone.

## The Building of the New C.G.T. Liner.

AN interesting section of the newly issued report of the Compagnie Générale Transatlantique deals with the construction of the company's new liner, which is to be named "President Doumer," and is now almost ready for launching at the yard of the Société des Chantiers et Ateliers de St. Nazaire. The construction of the ship, which will be propelled by turbo-electric machinery, was begun in January, 1931, and all being well she will be launched in October next and will enter the company's service some time in 1934. Her length is 1026ft., with a beam of 118ft. and a displacement of 67,500 tons on a mean draught of 36·6ft. with a measurement of about 75,000 gross tons. Her propelling machinery is being designed for a speed probably in excess of 28 knots, and she will be able to carry in three classes some 2000 or more passengers. The report states that the large sums necessary for her construction and the risks of a deficit being incurred by the putting into commission of such a large steamer have been the subject of negotiations with the French Government, which has assured the cost of construction over £3,200,000 at par by State guarantee. The growth of competition from Italian and German fast liners and the probable completion of the new Cunarder about the same time as the "President Doumer" have, the report states, convinced the board that the putting into commission of this new liner is a necessity.

# THE IRONBRIDGE POWER STATION OF THE WEST MIDLANDS JOINT ELECTRICITY AUTHORITY

*(For description see opposite page).*




TRI-DRUM STIRLING BOILER AND PULVERISED FUEL PLANT

## The Ironbridge Power Station.

No. II.*

For the first 50,000-kW set erected in the station the Stirling Boiler Company, Ltd., has installed three tri-drum boilers, each capable of generating 225,000 lb. of steam per hour at 400 lb. per square inch pressure and of giving a maximum output of 270,000 lb. per hour. The total heating surface of the individual units is 21,600 square feet. There are 931 main tubes and 66 cross tubes; in the front screen there are 146 tubes. The lengths of the front, rear, and mud drums are 33ft. 3in., 31ft. 3in., and 29ft. respectively, and whilst the two latter drums have a diameter of 54in., that of the front drum is 48in. All the combustion chambers and water-cooled hoppers are constructed on the Bailey principle, the total heating surface of the Bailey walls and front screen of each boiler being 3900 square feet. A three-header Stirling integral superheater with a total heating surface of 7134 square feet raises the steam temperature to 800 deg. Fah., or, in other words, imparts 353 deg. to the steam at the rated boiler output.

Each boiler—see page 200—has a Foster steel tube economiser, made by the Eco Power Company, Ltd. With a heating surface of 6864 square feet, these economisers give a water outlet temperature of 352 deg. Fah., with an inlet temperature of 300 deg., with gas inlet and outlet temperatures of 654 deg. and 508 deg. Fah. respectively. Two Howden Ljungström air heaters with a combined heating surface of 30,000 square feet are also fitted to each steam-raising unit, and with inlet and exit gas temperatures of 508 deg. and 270 deg. Fah., the air temperature is raised from 60 deg. to 390 deg. Fah. The resistance presented to the gas is 1·35in. W.G., and that to the air 1·5in. All figures relating to temperature, draught, &c., are those assumed for design, as no actual tests have been made, but there is every reason to believe that the results specified will be obtained.

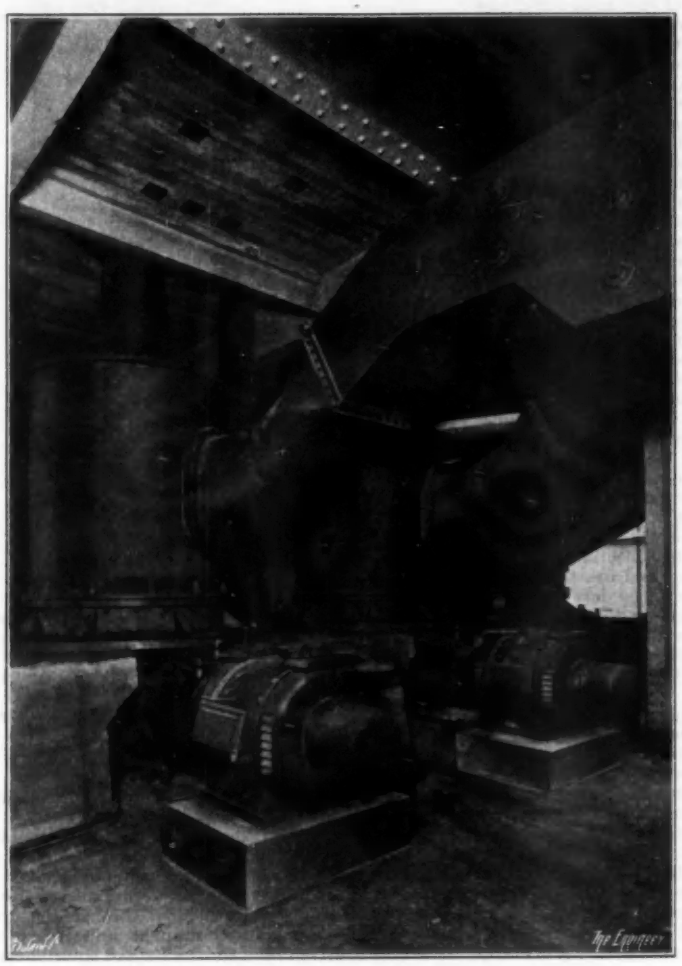


FIG. 14—PULVERISING MILLS

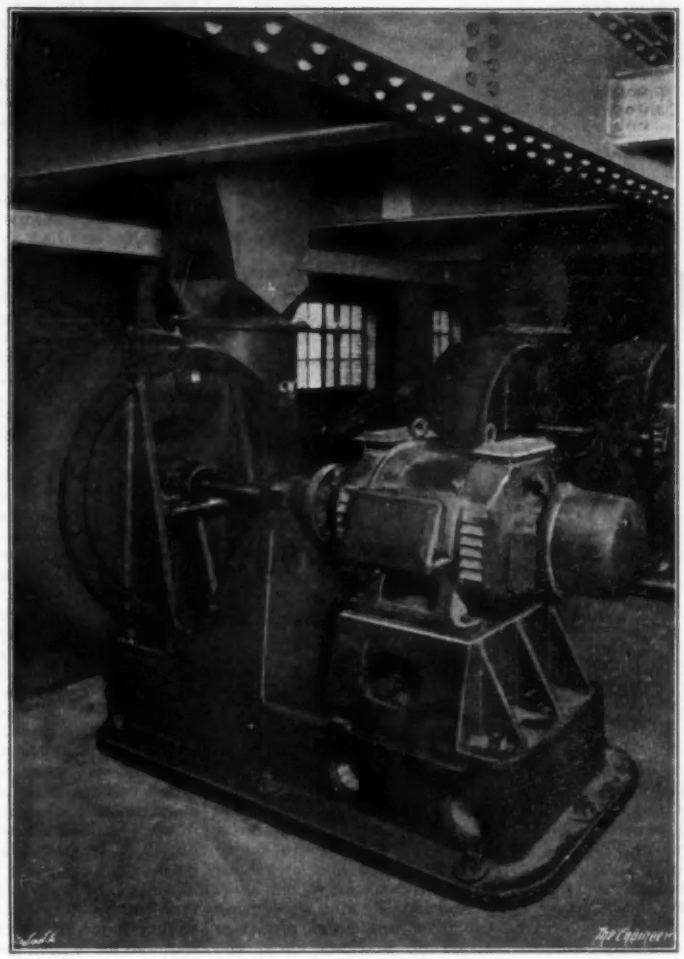


FIG. 15—EXHAUSTER FANS

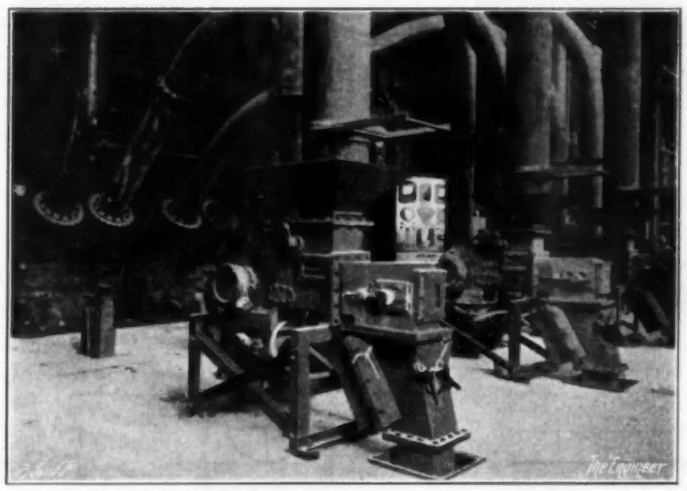


FIG. 16—BOILER FIRING FLOOR

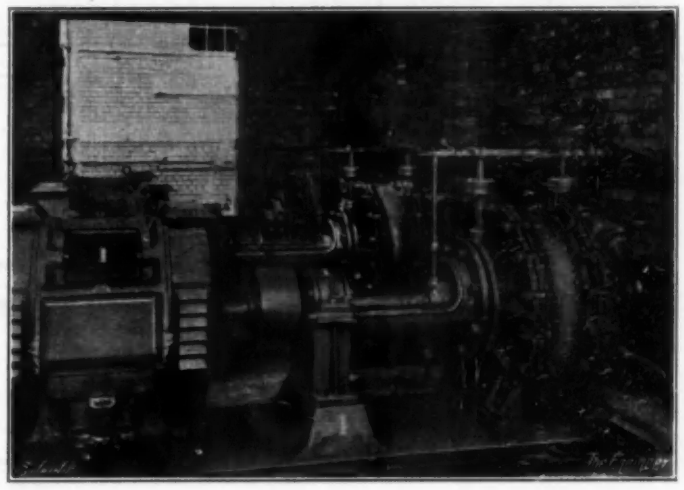


FIG. 17—"HYDROSEAL" SLUICE-WAY PUMPS

### Pulverised Fuel Equipment.

For each of the three boilers there is an independent pulverised fuel-firing equipment, composed of three "Lehigh" air-swept pulverising mills—Fig. 14—with their own independently driven drag feeder and capable of dealing with 17,920 lb. of coal per hour; three "Lehigh" exhauster fans—Fig. 15—and six "Calumet" inter-tube burners—Fig. 16—specially designed to fire through Bailey water-cooled walls. For starting up the boiler plant an oil firing plant, consisting of two air compressors and oil pumping sets, has been installed. Coal from the overhead bunkers shown on page 200 passes under the action of gravity and by way of the coal weighers to the feeders and, after traversing a magnetic separator which removes tramp iron, to the "Lehigh" mills where it is pulverised. In the mills the coal is dried by hot air drawn in at a temperature of about 160 deg. Fah. from the air duct in the front of the boiler, and is made to pass through the mills by the exhauster fans, which supply the "Calumet" burners with the coal and air mixture.

### Induced and Forced Draught Fans.

The "Sirocco" induced and forced draught fans, which were supplied by Davidson and Co., Ltd., of Belfast, operate in conjunction with thirty-six Davidson dust collectors. There are two single inlet induced draught fans for each boiler, and each is capable of handling 76,500 cubic feet of hot gas per minute when working against a total resistance of 8·75in. W.G. As shown in Fig. 18, there are six collectors in parallel for each fan, and there are therefore twelve collectors per boiler. The Metrovick three-phase squirrel-cage motors, which drive these fans, are wound for a pressure of 3000 volts, as in the

* No. I. appeared August 19th.

case of all other motors in the station with an output of over 75 horse-power. All A.C. motors below this capacity are supplied with current at 400 volts. Speed variation of the fan motors is obtained by means of Vulcan Sinclair hydraulic couplings made by the Hydraulic Coupling and Engineering Company, of Isleworth.

Referring to Fig. 19, each of these couplings consists of an impeller A mounted on the driving shaft

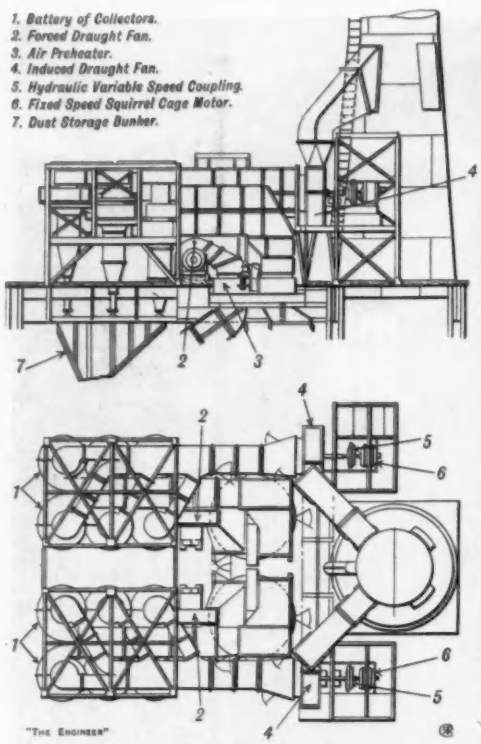

1. Battery of Collectors.
2. Forced Draught Fan.
3. Air Preheater.
4. Induced Draught Fan.
5. Hydraulic Variable Speed Coupling.
6. Fixed Speed Squirrel Cage Motor.
7. Dust Storage Bunker.
"The Engineer"

FIG. 18—FANS AND DUST COLLECTORS

and of a runner B on the driven shaft. The power supplied to the former is transmitted to the latter by liquid contained in the inner casing C, while an outer casing D forms a chamber in which a stationary scoop tube is housed. The impeller inner and outer casings are bolted together, and rotate as one unit, while the scoop tube, housing E, and supporting manifold F carrying the inlet and outlet pipes are stationary and are carried by brackets under the manifold. The power is transmitted entirely by the kinetic energy of the liquid, which is discharged by the impeller against the vanes of the runner, so that the speed of the latter is less than that of the former. When the casing is full of liquid, the driven shaft runs at its maximum speed, which is about 2½ per cent. less than that of the driving shaft, but by varying the amount of liquid in the coupling the speed can be decreased continuously, and to any desired degree. This is done by circulating a small quantity of liquid supplied from a tank G through a control weir H operated electrically from the boiler house floor, and from the weir the liquid flows through the pipe K to the inlet branch of the manifold F. The liquid then passes through the ports in the housing E and runner B into the working chamber, from which it is forced by centrifugal pressure through ports in the casing C into the chamber formed by the parts C and D, in which the scoop tube is housed. From the chamber the liquid is removed by the scoop action of the scoop tube, and is ejected through ports in the housing E and manifold F, *viâ* the pipe L back to the tank G. Obviously the quantity of liquid in the coupling, and hence the speed of the driven portion, depends on the setting of the control weir, and the driven shaft always runs at definite speed under constant load. For the reception of any drainage oil which may pass the thrower rings in the manifold and for taking the excess oil draining from the coupling in the event of the motor tripping out or shutting down with the coupling full, a sump tank M is provided, and is automatically emptied by an ejector operated by the pressure oil in the discharge branch.

Each battery of six dust collectors is on the inlet side of the fan, so that the dust-laden gases enter directly into the collectors before passing through the fans, thus preventing erosion of the casings. With the principle of these dust collectors most engineers are now familiar. Briefly, the horizontal casings through which the gases pass are of volute shape, and as the dust is heavier than the gases it is forced out against the periphery, the effect increasing as the radius of the volute decreases. Owing to its greater specific gravity the dust follows a downward spiral path through a series of alternate truncated cones and cylinders until the dust outlet at the bottom of the collector is reached. The cleaned gases forming a vortex through the centre of the collector pass out at the exhausts heads at the top and are then taken through the fan to the chimney. the dust from each battery of collectors being discharged into a common storage bunker beneath. As the dust separating action is obtained by the centrifugal effect due to the velocity of the gases passing through the collectors, it is obvious that with the wide range of duties imposed on modern station boilers, the peak load of which is often practically twice that of the normal load, it is extremely difficult to obtain the same high collecting efficiency at all times. But by using a number of relatively small dust collectors in parallel, as at the Ironbridge station, the number of collectors in use at any time can be varied according to the load on the boiler, and the maximum efficiency can thus be maintained under practically any load condition.

At Ironbridge it is anticipated that not more than four out of the six collectors in each battery, or twenty-four out of the total of thirty-six, will be required for normal duty. By means of dust made up to represent as nearly as possible that which will be met with in practice very complete tests were carried out on these dust collecting units. Eighty per cent. of the mixture used consisted of dust from an existing pulverised fuel installation and was caught in suspension by Davidson collectors, whilst the remaining 20 per cent. by weight consisted of still finer dust taken from a similar installation, but which had not been caught by centrifugal or electrostatic means. In order to expel all moisture and to reproduce as far as possible the conditions met with in practice the mixture was heated overnight and the results of ten tests taken with varying concentrations of dust and representing normal boiler full-load conditions and soot blowing conditions showed an average collecting efficiency of 95·76 per cent.

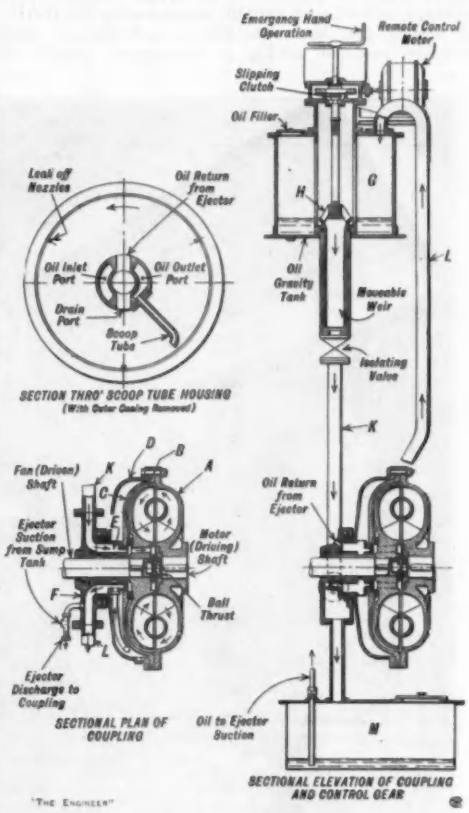



FIG. 19—SINCLAIR HYDRAULIC COUPLING

There are two 35in. diameter "Sirocco" double-inlet forced draught fans per boiler, each capable of handling 41,000 cubic feet of air per minute against a resistance of 8in. W.G. and of delivering this quantity of air to the combustion chamber through the preheater. Like the induced draught units, each of these fans is driven by a constant-speed squirrel-cage motor and the necessary speed variation is obtained by Sinclair hydraulic couplings.

Superheated steam delivered by each boiler is supplied by one 16in. diameter main steam pipe to a forged steel receiver in the turbine room, all high-pressure steam pipe joints consisting of a mild steel serrated ring. The tops of the chimneys are approximately 200ft. above the boiler-house ground level, and with a diameter of 9ft., each chimney will be

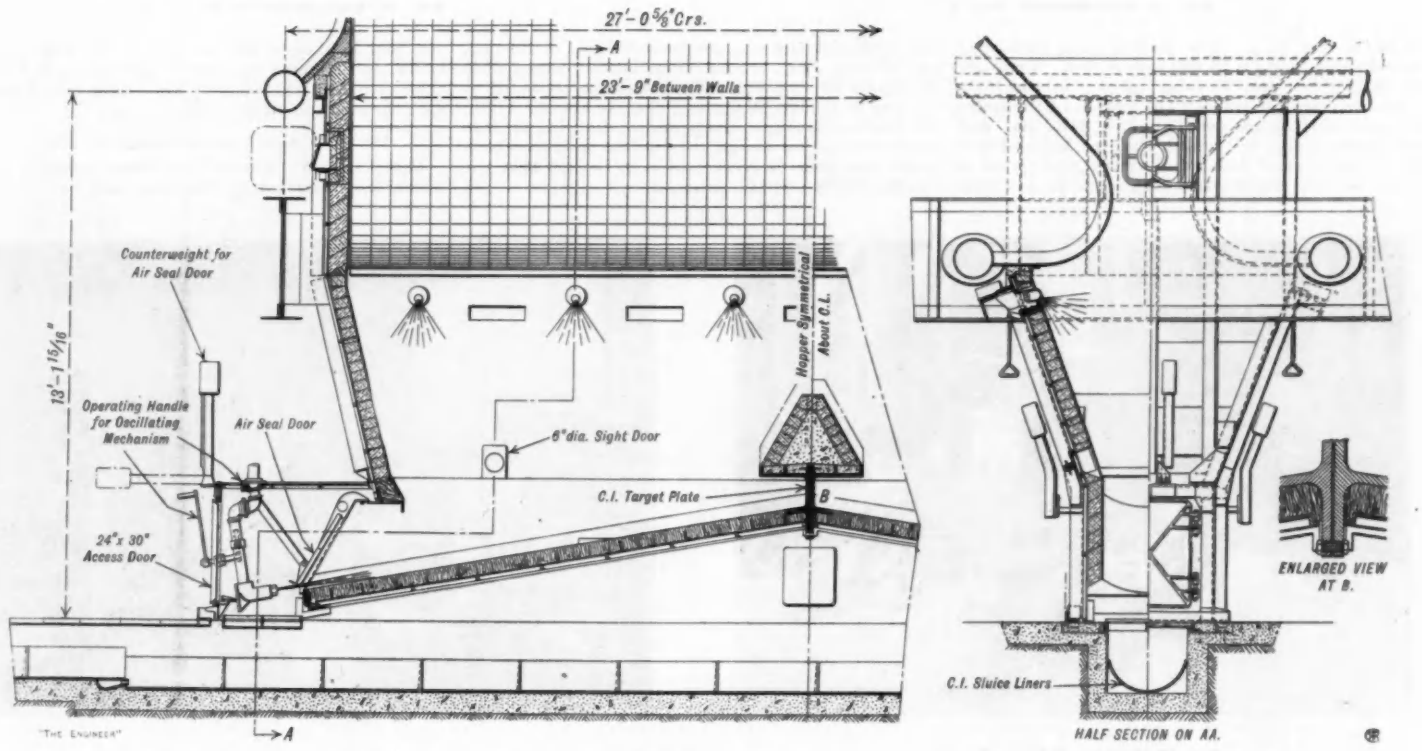



FIG. 20—DETAILS OF ASH HOPPER

capable of taking the gases of one additional boiler when the second battery of steam raising units is installed. Each boiler has sixteen soot blowers, supplied by the Diamond Soot Blower Company, Ltd. The boiler mountings were made by Hopkinson, Ltd., the feed water regulators by Copes Regulators, Ltd., and the boiler instrument panels, shown in Fig. 22, by Industrial Combustion Engineers, Ltd. The panels are composed of stainless steel manufactured by Orme Evans and Co., and the instruments mounted on them are draught gauges, a steam gauge, a remote water level indicator, a Bailey meter and indicator, a $CO_2$ indicator, and a multi-point temperature indicator, together with the control handles for the hydraulic couplings. A passenger and goods lift has been installed in the boiler-house by J. and E. Hall, Ltd., of Dartford.

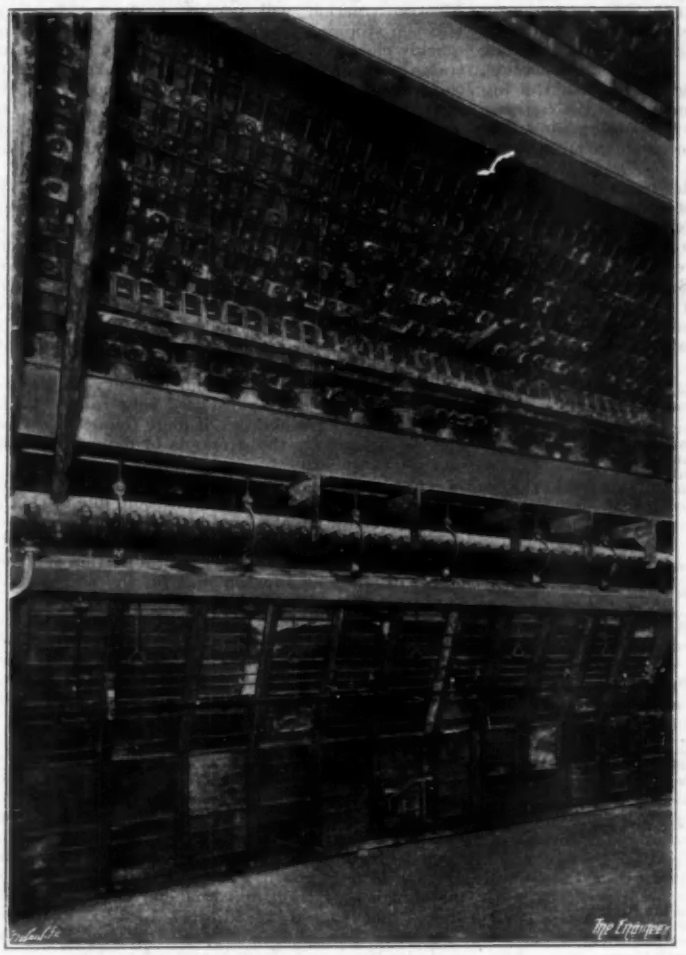


FIG. 21—EXTERIOR OF BAILEY WALL AND ASH HOPPER

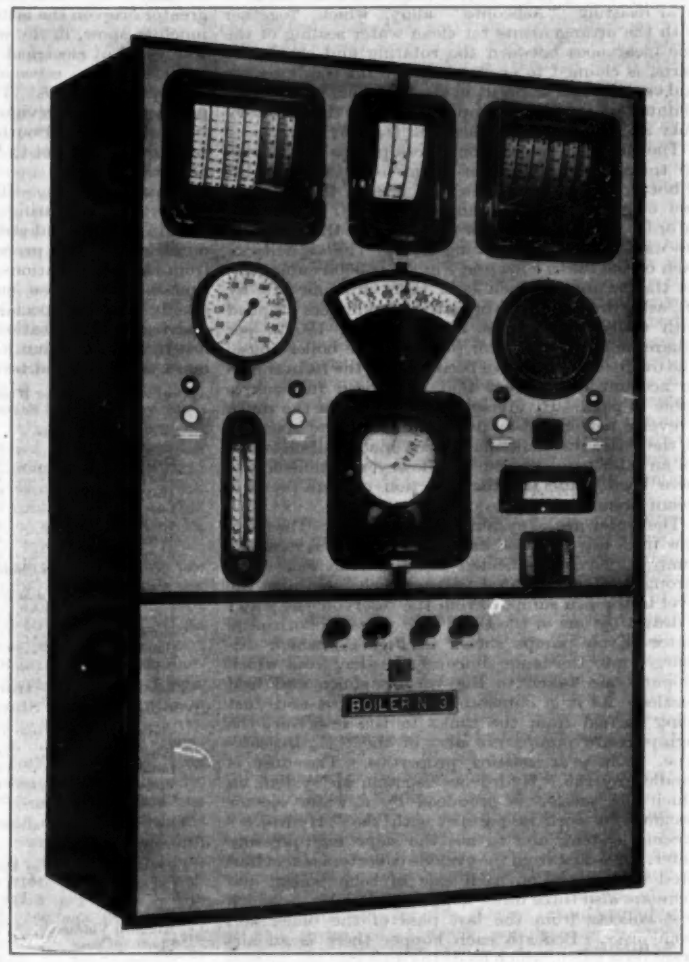



FIG. 22—BOILER INSTRUMENT PANEL

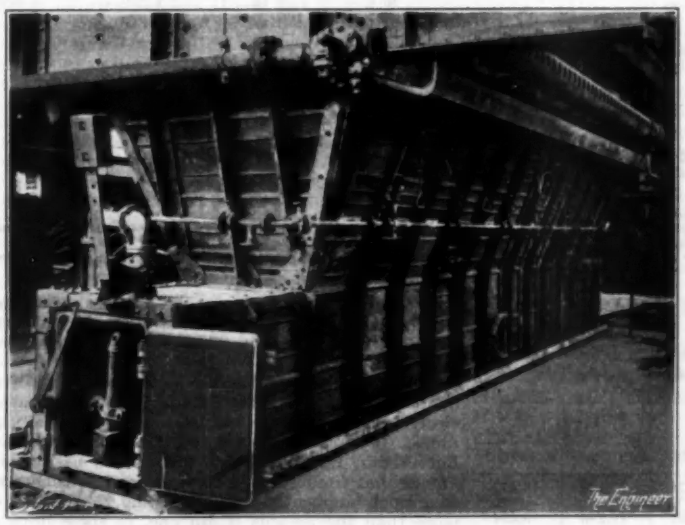


FIG. 23—ASH HOPPER

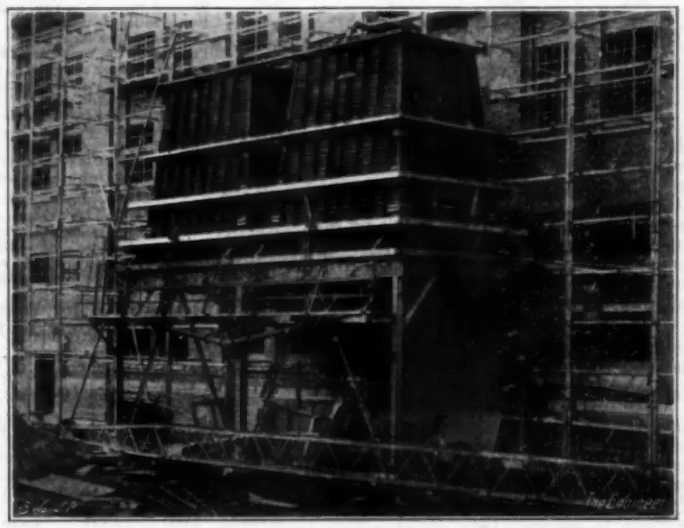


FIG. 24—ASH TANKS

### ASH HANDLING PLANT.

The ash is handled by a "Hydrojet" plant supplied by the Ash Company (London) Ltd., which has installed similar equipments in a number of other modern power stations. The system is essentially a totally enclosed and intermittent system, in which the ash is accumulated for a period in hoppers beneath the furnaces. Having been made cool and dustless by quenching, it is then fed out once a day or once a shift at a rate of 1 to 1½ tons per minute into a horizontal high-velocity sluiceway and is carried to a central sump at one end of the boiler-house. As quenching water which has been in contact with ash is very corrosive, the hoppers in which the ash is accumulated are built up of cast iron panel plates held on to a steel framework by recessed lugs which receive the holding bolts, a form of construction which avoids the necessity for steel bolts passing into the interior of the hopper which presents nothing but an unmachined cast iron surface inside. The hopper walls are lined with refractory bricks, but where the walls are vertical, diamond-shaped locked tiles are used and each tile is individually supported by sloping shelves cast integrally on the plates. Where the walls are sufficiently battered every third or fourth course of standard fire-brick is held by ledges on the plates, thus ensuring that in the event of a brick failing the remainder of the wall will be unaffected.

The ash hoppers shown in Figs. 20, 21 and 23 are formed below the hoppered portion of the furnace, and are supported from the floor, whilst an expansion joint between the Bailey wall tubes and the top of the hopper accommodates the vertical movement of the spring-supported Bailey walls. At the bottom of each hopper—see Fig. 20—there are two inclined feed plates upon which the ash rests. At the outer end of each of these plates there is a counterpoised air seal door in front of which is a hand-operated feed nozzle. Both the air seal door and the nozzle are covered by an access door, as shown. When it is necessary to empty the ash hopper the feed nozzle is turned on and a high-velocity stream of water is projected upwards parallel to the feed plate, and results in the ash being fed out into the sluiceway in a regular and controllable manner at the rate of about 1 to 1½ tons per minute. On entering the sluiceway, other high-velocity jets of water, spaced at appropriate intervals, pick up the ash and convey it to the sump. The initial velocity of these jets is in the neighbourhood of 120ft. per second, which gives the sluice a very high capacity, allows it to run horizontally and enables it to carry pieces of clinker of from 10in. to 12in. cube without danger of clogging. The sluiceway is formed of half-round liners dropped into a concrete trench, 24in. wide. No wedging or

grouting in is required, for the liners are self-fixing, and the whole structure is enclosed by self-sealing, concrete-filled removable cover plates. At the end of the boiler-house this sluiceway, which runs beneath the three hoppers, discharges the ash and water into a cross sluice, which conveys it to the ash sump, where there are three vertical-spindle "Hydroseal" ash pumps of the single-stage, centrifugal type. All the parts of these pumps subject to abrasion are made of wear-resisting "Ashcolite" alloy, which, together with the arrangements for clean water sealing of the fine clearances between the rotating and stationary parts, is claimed to ensure long life for the impellers and casings, and to result in the initial efficiency being maintained. As each pump can perform the necessary duty alone, two of them serve as standby units.

The discharge pipes from these pumps are carried up the wall of the boiler-house to a two-way distributor, which discharges into one or the other of two overhead water drainage storage tanks, and in order to minimise wear all bends in the pipe line are made of a wear-resisting alloy. The capacity of each of the tanks shown in Fig. 24 is 3000 cubic feet. At the bottom of each tank there are four 4ft. by 6ft. ash gates, which are operated by cylinders supplied with transformer oil at a pressure of 180 lb. per square inch by two motor pumps in the boiler-house. The overhead tanks have been built in the form shown on account of the fact that pulverised fuel ash is liable to pack. By giving the four sides of the tanks a reverse batter and by providing large gate openings at the base, the tanks have been made self-cleaning. As an additional precaution, however, arrangements have been made for the injection of high-pressure steam around each gate opening.

The water in the system is re-circulated. The overflow from the overhead ash tanks is led to a reservoir sump which is connected back to the ash sump through a float-operated valve, which maintains the level in the ash sump. From the reservoir the water is drawn by one of the three high-pressure horizontal motor-driven pumps shown in Fig. 17, which discharges into the main sluiceway header, from which tappings are taken to the various sluice and feed nozzles. As it is impossible to avoid grit and dust being carried from the tanks to the reservoir, the high-pressure pumps are also of the "Hydroseal" type, with wear-resisting properties. The dust is handled by the "Hydrovac" suction air system, in which the suction is produced by a water ejector designed to work in parallel with the "Hydrojet" sluicing system, and to use the same high-pressure water. The dust from the cyclone collectors is accumulated in hoppers on each side of each boiler, and there are also three other hoppers per boiler, in which dust collects from the last pass of the boiler and economiser. Beneath each hopper there is an air-swept dust valve, which feeds the dust into the suction line in proportion to its carrying capacity, and so precludes the possibility of the line being blocked. The suction lines are connected to water ejectors, and on the arrival of the dust at the ejectors it is intimately mixed with the water and discharged into the top of the two-way distributor in the overhead ash tanks.

*(To be continued).*

# The Economics of Urban Electric Railways.

By HENRY WATSON.

No. VI. (*conclusion*).*

MISCELLANEOUS ASPECTS AND CONCLUSIONS.

IN this, the final article of the series, we may consider certain miscellaneous aspects and statistics bearing on the traffic needs of electrified suburban lines and new electric railways.

*Comparative London Railway Traffic Figures.*—We have compared the growth of traffic on the Southern Railway's electrified lines with that on the other London lines, mostly steam operated, in article No. III. Further light on this matter is thrown by Table XVIII., extracted from the Third Annual Report of the London and Home Counties Traffic Advisory Committee. It will be seen that the ordinary passenger totals of the trunk railways hardly changed from 1919 to 1927; that the workmen's traffic had fallen by 19 per cent. to 26 per cent.; and that the season ticket traffic had declined 24 per cent. on the steam-operated L.N.E.R., but only 3 per cent. on the Southern, from the boom year of 1919, though the latter's workmen's traffic had declined more. The last is, however, a less desirable traffic. In all, the Southern total fell 10 per cent. from the boom year, and the L.N.E.R. total fell by 16 per cent. On a revenue comparison there was probably a 10 per cent. greater drop on the latter. But the difference was not much to show, in the writer's opinion, for eight post-war years of electrical working, with ever-increasing train services, especially on the Eastern section, electrified in 1925. These figures confirm the impression gained previously, namely, that the response to the improved Southern service is slow, and that early profits are not to be expected under present-day conditions.

*Trains per Day.*—The following figures are of interest in indicating the intensity of service on certain electric and steam railways. They show the number of trains proceeding to a London terminus from suburban stations, as revealed by the published time-tables. Those on the Southern Railway are mostly electric, especially from stations off main lines and from minor stations. Most of them stop at all nearby stations, but they may proceed to two or more widely spaced terminals.

*Approximate Trains per Week-day Bound for a London Terminus. Southern Railway.*

| Terminal stations. | | Intermediate stations. | |
|---|---|---|---|
| Epsom Downs | 85 | Lewisham | 206 |
| Orpington | 76 | Putney | 160 |
| Dorking | 70 | Surbiton | 145 |
| Hayes | 60 | Thornton Heath | 144 |
| Caterham | 54 | Woolwich Arsenal | 95 |
| Guildford* | 46 | | |
| Windsor | 43 | | |
| Shepperton | 36 | | |

* *Vid* Clandon electrified line.

*London and North-Eastern Railway.*

| | | | |
|---|---|---|---|
| Ilford | 136 | Leytonstone | 68 |
| Enfield Town | 110 | Romford | 61 |
| Clapton | 108 | Loughton | 51 |
| Chingford | 101 | | |

The number of trains entering main termini is given in "London Statistics" as follows:—

*Suburban Trains into Termini in July, 1929, per Day.*

| | | | |
|---|---|---|---|
| Waterloo | 513 | Cannon-street | 181 |
| London Bridge | 439 | Holborn Viaduct | 121 |
| Victoria | 417 | Liverpool-street | 492 |
| Charing Cross | 287 | | |

This book also shows the growth of services on different lines:—

*Increase in Number of Trains into Termini from December, 1913, to July, 1929.*

| | Per cent. | | Per cent. |
|---|---|---|---|
| Waterloo | 80 | London Bridge | 24 |
| Holborn Viaduct | 71 | Victoria | 5 |
| Charing Cross | 54 | Liverpool-street | 17 |
| Cannon-street | 48 | King's Cross | 8 |
| | | Marylebone | 11 |

It may be noted that in Glasgow about 74 trains arrive from Queen's Park, on the well-known Cathcart Circle, per day, and that there are roughly 85 trains per day arriving from Paisley.

A scheme for electrifying the L.N.E.R. (G.N. section) lines out of London was published. This contemplated 60 route miles or 173 track miles, now carrying 2,000,000 steam train-miles per annum. This mileage was to be doubled, thus decreasing an average service interval of, say, 24 min. to 12 min. Table XIX. gives data on suburban electric railways.

*Track Congestion.*—On certain intensely operated railways, more especially in London, the possibilities of increasing the rush hour service are seriously limited by the track capacity outside the city terminals. A large number of trains may converge from over a wide area, and have to pass through a bottle-neck. The cost of widening, or of eliminating flat junctions, to secure a higher frequency of service, is prohibitive. Electric traction will permit a shorter headway between stopping trains, since sections can be more quickly cleared and entered with rapidly accelerating trains. The advantages of electrification in regard to terminal operations are often overstated, but the writer believes that it would be fair to put the increased track capacity for stopping trains at, say, 25 per cent., assuming in both cases equally up-to-date signalling.

Now electrification is commonly advocated in London, not so much for the faster and more frequent midday service it would probably provide, but in order to secure a more adequate rush-hour service over congested tracks. It should be recognised, however, that the potentialities of improvement in this direction are limited, and that whilst a 25 per cent. increase of capacity would be valuable, it would soon be absorbed by fresh traffic and by passengers now carried possibly under conditions of acute discomfort. Any great increase of rush-hour capacity must come from new and heavily subsidised tube railways. In slack hours the possibilities of more frequent services may be limited by the demands of main line traffic into the terminals.

*Miscellaneous Advantages.*—Further economic benefits may result from electrification, due to (1) the electrical operation of main line and goods trains over the suburban zone; (2) the reduction of maintenance cost of structures by reducing the proportion of steam trains discharging fumes; and (3) the enclosing of lines or stations for building over and letting at high rentals. No examples exist in this country of any benefit resulting from items (1) and (3), and we are not encouraged to expect much in this direction as yet. Even the Southern Railway shows no signs of desiring to operate main line steam-hauled trains electrically in its suburban zone.

*Possibilities of Independent Units.*—A three-coach unit has to develop an output of some 800 horse-power when leaving a station. Independently propelled trains, of the oil-engined type, could not give this great peak output so economically and conveniently, at suburban frequencies, as electric trains. Consider estimate D in the first article. With an average of 5·14 coaches per train the total for fuel, maintenance of train and financial charges thereon should not exceed 24·8d.=(11·4+3+2+0·6+3·6+4·2)d. The enormous peak output demanded excludes these units from heavy urban duty.

*Observations on Suburban Electrification.*—The desirability of electrification as a profitable venture cannot be discussed without reference to the type of scheme contemplated and the period of waiting for profits that is acceptable. Distinction is necessary between bold and conservative schemes, according to the frequency of the present steam service and the extent it is proposed to augment it under electrical operation.

We must deprecate the uncritical attitude so often adopted towards reports of traffic increase, following electrification, and the over-statement of its advantages. It is easy to believe what we like to believe, but certain railway boards are not so easily convinced that traffic will, in fact, respond satisfactorily to a much augmented service, costing 25 per cent. or more than the present steam one, in these days of intensive road competition by omnibus, coach, and tram. Traffic can be easily pulled off railways and is not nearly so easily drawn back. The inadequate and sometimes misleading information disseminated by certain authorities as to the operating costs and revenue of their electric services encourages this attitude of scepticism.

But this is no excuse for an attitude of *laissez-faire*, and there are many cases where conservative schemes can be justified, even to-day, *i.e.*, where the present steam service is of high frequency. Our railway companies cannot be absolved from the charge of undue conservatism in this matter, when the character

TABLE XVIII.—*Number of Railway Journeys from Stations in London in Metropolitan Police and City District, i.e., Within About 15 Miles from Charing Cross, Month of May, Thousands.*

| Railway. | Ordinary. | | Workmen. | | Season. | | Total. | |
|---|---|---|---|---|---|---|---|---|
| | 1919. | 1927. | 1919. | 1927. | 1919. | 1927. | 1919. | 1927. |
| Southern | 6,535 | 6,347 | 4,690 | 3,452 | 5,883 | 5,678 | 17,108 | 15,477 |
| Increase or decrease | | −3% | | −26% | | −3% | | −10% |
| L.N.E. | 3,416 | 3,403 | 3,000 | 2,429 | 4,820 | 3,662 | 11,236 | 9,494 |
| Increase or decrease | | 0 | | −19% | | −24% | | −16% |
| L.M.S. | 1,750 | 1,761 | 2,553 | 1,995 | 1,686 | 1,799 | 5,990 | 5,555 |
| Increase or decrease | | 1% | | −22% | | 7% | | −7% |
| Underground Group | 23,464 | 17,606 | 5,785 | 4,251 | 3,945 | 3,774 | 33,194 | 25,631 |
| Increase or decrease | | −25% | | −26% | | −5% | | −23% |
| Metropolitan | 7,029 | 3,519 | — | 804 | 1,352 | 1,599 | 8,381 | 5,923 |
| Increase or decrease | | −50% | | | | 18% | | −29% |
| Total, including other lines not given | | | | | | | 79,465 | 65,254 |
| Increase or decrease | | | | | | | | −18% |

* No. V. appeared August 19th.

TABLE XIX.—*Suburban Electric Railway Statistics, 1931.*

| Company | Southern Railway (London). | L.M.S. Railway (London and Lancashire). | L.N.E. Railway (Tyneside). | Metropolitan Railway (London). |
|---|---|---|---|---|
| Passengers carried by electric trains or in electrified area, millions | 218 | — | — | — |
| Electric train miles run, millions, gross | 20·6 | 6·48 | 1·279 | 6·129* |
| Route miles electrified | 290 | 105 | 32 | 31 |
| Passengers per train mile | 10·6 | — | — | — |
| Passengers per route mile, thousands | 752 | — | — | — |
| Train miles per route mile, thousands | 71 | 61·6 | 40 | — |
| Average service interval, minutes | 11 | 13 | 20 | — |
| Motor coaches in stock | 905 | 293 | 87 | 211 |
| Trailer coaches in stock | 622 | 397 | 55 | 392 |
| Sets of eight coaches in stock | 216 | 86½ | 17¾ | 75½ |
| Miles run per eight coaches in stock | 95,000 | 75,000 | 72,000 | 81,000 |
| Maintenance cost per motor coach, £ per year† | £197 | £381 | £181 | £343 |
| Electric train working, pence per train mile | 9·14d. | 14·7d. | 11·4d. | 10d. |

* By companies' motor coach trains.

† Metropolitan Railway carried 128 million passengers with 5·75 million train miles in relation to total expenditure for a revenue of 1·36 million pounds=57d. per train mile, and 2·65d. per passenger.

Southern electric train revenue "nearly £5 million," equals nearly 5¼d. per passenger, nearly 58d. per train-mile, or nearly £17,000 per mile of route annually.

of their service could have been so much improved—if only in regard to the speed of their stopping trains—for no more than a 10 per cent. revenue increase, if that. This is especially so as regards former years, when traffic invariably responded quickly and handsomely to such improvements.

Railways faced with competition must—as with other businesses—decide whether they will adopt a bold policy of greatly improved service, involving greater capital commitments and operating expenditure, or whether they will follow a negative and conservative one. The decision must turn on a comparison of the amounts risked and the probabilities of revenue responding. This is vitally dependent on whether the proposed scheme is a bold or a conservative one as defined previously.

There is hardly a sharp demarcation between the success or failure of an electrification programme. Some railway boards may demand fairly early profits before they are interested in a proposal, whilst others may be content to wait. The Southern Railway Company is building for the future, and though the revenue response to its electrification scheme in post-war years is slow, it must not be considered that such was in any way ill-advised, in general, though it is probable that certain routes and service intensifications have yet to justify themselves. The board of this company may be quite prepared to wait for profits—over ordinary interest rates—for twelve or more years. But other companies may not be attracted by such an outlet for capital.

The advisable policy for our railway companies would seem to be one of electrifying the high-frequency lines, with but limited increase of train mileage, whilst endeavouring to secure some restraint on unnecessary road competition which does, in fact, deprive them of passengers who could be carried thereby fairly conveniently. This restraint would apply only concurrently with the initiation of a first-class electric service over a wide area. Extensive and bold schemes must await some control of road competition.

There are probably a number of border-line cases where the public would have at least a faster service, but where the company would derive but mediocre profits from an electrified line. There is a need for agreement between the public—as represented by Government Departments, municipal authorities, and licensing commissioners—and railway companies, whereby the former can guarantee a restraint on long-distance road services, or even a given aggregate of revenue in return for a specified electric service. It should not be impossible to formulate agreements that would protect either party from exploitation. Municipal transport operators would then work to deliver traffic to the railways, and not to drain them, by express and through omnibus services into town, and by ultra-low tram fares. On the other hand, the railway fares would have to be as low as would enable the suburban services to be remunerative without yielding large surpluses to support the rest of the railway. The writer contends that it is not impossible for accountants to evolve a separation of the operating costs and revenue of suburban and main line traffic.

*The Edgware and Morden Tube Extensions.*—Some traffic figures relating to these lines, given to the writer by the London Underground Railway Companies, are of interest. The number of passengers to or from stations between Golders Green and Edgware inclusive in the year 1930 was 18·8 million. The extension is some 5 miles long, is all on the surface, and includes six stations, with Golders Green. The average fare paid may be put at 4d. There were thus 3·8 million rides per mile, and the revenue per mile was £63,000. This revenue must, however, cover less remunerative miles into the city. If we can fairly say that this line serves all the population of Hendon Urban District Council and of Kingsbury, it serves a population of 133,000, thus yielding 142 rides per head per annum, worth 47s. 6d. The revenue per station was £52,000.

The number of passengers to and from stations between Clapham Common and Morden inclusive was 30 million in 1930, at an approximate average fare of 3·8d. This extension is 5¼ miles long, is practically all underground, and has eight stations. The passengers per mile were thus 5·7 million, and the revenue per mile £90,000. We might regard this line as serving a third of the population of Wandsworth a quarter of that of Wimbledon, and all that of Merton and Morden, giving a total of 175,000. This yields 171 rides per head, worth 54s. per year. Revenue per station equals £60,000. Both these extensions are financially very satisfactory.

*Some Tube Schemes in Hand.*—The New Southgate extension, 7½ miles long, of which 4 are in tunnel, is said to have cost £5,300,000, including eight new stations, five sub-stations and rolling stock. The 4½-mile Northfields extension, on the surface, with five sub-stations and rolling stock, is quoted at £3,000,000. Cars to the number of 275 are required for the two extensions. These figures are in line with our own. The 1¾-mile Camberwell Green extension is reported to involve an expenditure of £1,875,000—a high value.

*Population per Mile Required.*—The traffic requirements of railways may be expressed in terms of population served. The following table relates to fairly long lines on which the revenue from intermediate stations is of the first importance, *i.e.*, to belt lines :—

| | New surface railway in outer suburbs. | New tube railway in inner suburbs. |
|---|---|---|
| Revenue required per mile | £30,000 | £75,000 |
| Assumed rides per head | 150 | 150 |
| Assumed average fare | 4d. | 3d. |
| Revenue per head | 50s. | 37s. 6d. |
| Population served per mile | 12,000 | 40,000 |
| Passengers booking per mile per year | 1·8 million | 6 million |
| Assumed population density, per acre | 15 | 60 |
| Acres served per mile | 800 | 660 |
| Width of belt served per mile | 1¼ miles | 1 mile |

*Effect of Station Spacing.*—An intermediate tube station with three escalators will cost, roughly, £75,000. If stations are 1¼ instead of ¾ mile apart, the construction cost and revenue required will be reduced by about 10 per cent., and train speeds can be raised to, say, 25 m.p.h. But such a spacing would entail too much loss of traffic in heavily developed areas, and a spacing of under ¾ mile is there common and desirable.

*Use of Urban Railways Abroad.*—In 1929 the Rapid Transit lines of New York carried 1972 millions of passengers over 637 miles of track. The Subway Division of the Interborough Company carried 932 millions over 86 route miles of subway, at an average fare of just over 5 cents, or 2½d. The revenue per route mile was approximately £116,000 a year—a very high figure.

The Paris Metropolitan carried 850 million passengers in 1929 over 75 route miles of underground railway, for an average fare of 80 centimes, or 1·6d. This yields £75,000 per mile of route annually. This mileage is concentrated almost entirely within a radius of 3½ miles.

Both New York and Paris make a remarkable use of subways, and show between 200 and 300 rides per head per year thereon, whereas London only attains to about 125. The former is due to a high population density, poorer road services, congested streets, frequent stations, and the elongated shape of Manhattan. The extent that the Paris system has been developed, in spite of competition from a widespread tram and omnibus system, and the absence of country extensions or "tube dormitories," is not easily reconciled with our own policies and ideas, and the economic aspect of the Parisian services therefore merits study.

*London Railway Statistics.*—Greater London has some 650 route miles of railway, of which 109 miles are local, the remainder being owned by trunk and joint companies. In 1929 they carried 962 million passengers, according to "London Statistics," and probably earned roughly £27,000 per mile. The Underground group carried 392 of the 616 million local passengers.

Table XX. gives statistics of the operating results of the London Underground Companies, and shows the revenue in terms of route and train mileage, &c. Inter-running makes the figures approximate, especially as regards the first column. The following data will also be of interest :—

| | |
|---|---|
| Average rate of ordinary fare per mile, all lines | 0·8d. |
| Average seat-miles run per passenger | 11 |
| Average minutes interval, all tubes | 3 |
| Average cars per train, all lines | 4·7 |
| Average distance between stations, all lines | 0·62 mile |
| Average seats per car | 45 |
| Average miles run per car in stock per annum | 46,800 |
| Average speed of trains | 17 to 21 m.p.h. |

*Observations on Tube Railways.*—Tube development in London of recent years has taken the form almost exclusively of extensions of lines hitherto terminating in inner suburbs into more or less open country, where new tube-monopolised suburbs would grow. There has been practically no new construction in the central business area—save of short junction lines—and none in already highly developed suburbs, if exclusively confined thereto. The new areas sought have not had direct railway facilities before, were too far out for the railway to be seriously menaced by road competition, and were free from competitive municipal tramways.

The inner London tube network was constructed almost entirely prior to 1908, when construction costs were low, money was cheap, and motor omnibus competition was a factor whose potency had yet to be established. It cannot be said that this network is ideal and complete, yet no new schemes for new lines therein are forthcoming to-day. The Central London Railway, whose routing must be most effective, earns less than £80,000 per mile, with a fare rate of nearly 1d. per mile, yet this revenue is barely sufficient for a line constructed to-day. New tubes in this area are unlikely to be built unless a very considerable restraint is placed on the omnibus services, and even then a heavy subsidy would still be necessary.

Tube development in London has had a stimulus not generally available in other cities, in the exclusion of railways and tramways from large areas in the central and high-class suburban districts and from the narrow and inefficient street system therein. Municipal electric tramways, traversing good open streets, with widespread services and very low midday fares, can be a serious competitor, particularly when many slack hour passengers are not pressed for time.

Tube railways have not been extended into the densely populated suburban areas on the eastern side of London for very good reasons. Such are threaded by surface railways, which, however inefficient and inadequate they may be, must be a constant menace to any new line nearby. They are, moreover, covered by effective municipal tramways with their workmen's and low midday fares. Demands for tubes, owing to the inadequate rush-hour capacity or unsatisfactory character of the existing steam service, or to a desire for a through service into the central underground network, are of themselves quite inadequate to justify tube construction as separate profit-earning ventures, when revenues of the order of £75,000 per mile are sought. Such revenues are possible only by monopolising the daily long-distance riding of some 40,000 or more people per mile of route. Surface railways can be electrified and improved out of recognition to provide a service of comparable efficiency to that of a tube railway as commonly understood in London.

Favourable conditions exist for tube railway extension where virgin country can be reached within a few miles, where such is untapped by any railway, and too far out or too badly served by road facilities to be menaced by road competition for most of its traffic. Where the expanding wave of urbanisation has been held back there may be opportunities of reaching new ground, suitable for good-class housing development, within a short distance. The Golders Green line reached virgin country within 4 miles of the general tube network, which country was connected to the town only by tortuous roads over high hills.

Proposals for underground railways in provincial cities invariably display a lack of appreciation of the enormous amount of long-distance traffic that is necessary to justify them. Such cities have considerable passenger traffic, but it is short-stage travelling and cannot be successfully diverted underground. A radius of 4 miles encloses most of the built-up area and seldom, if ever, excludes suburbs of the order of 150,000 population, essentially dependent on the city proper. As a contribution to the easing of street congestion the capabilities of underground railways are very limited.

TABLE XX.—*London Underground Railway Statistics (Approximate), 1931.*

| Company | Metropolitan District. | London Electric. | City and South London. | Central London. | Total. |
|---|---|---|---|---|---|
| Gross traffic receipts, £ thousands* | 1,471 | 2,330 | 958 | 508 | 5,267 |
| Passengers carried, millions | 133 | 154 | 63·4 | 44·2 | 395 |
| Gross train miles operated, millions† | 4·78 | 7·98 | 3·33 | 1·95 | 18·04 |
| Route miles owned | 26 | 31½ | 12½ | 7 | 76¾ |
| Cars owned | 563 | 1,093 | 114 | 259 | 2,029 |
| Receipts per mile of route owned* | £57,000 | £74,000 | £75,000 | £73,000 | £69,000 |
| Receipts per passenger | 2·65d. | 3·63d. | 3·63d. | 2·76d. | 3·2d. |
| Receipts per train mile*† | 74d. | 70d. | 69d. | 63d. | 70d. |

*After operation of common fund. † In relation to companies' total expenditure.

*Necessity of Feeding Railways.*—Most railways in our large cities are essential, if only for rush-hour traffic. Their operating costs bear little relation to the traffic carried, and their passenger capacity can be increased up to certain high limits at a trivial cost. Accordingly it is only logical to concentrate upon them all possible traffic, to reduce the cost per passenger carried, or to release revenue for improvement and extension in temporarily unremunerative directions. Opinions will differ as to how far road traffic can be legitimately diverted thereto, but it must be recognised that the preferences and conveniences of certain travellers, especially in slack hours, must be subordinated to the necessities of the community as a whole. When railways are seeking a 25 per cent. to 50 per cent. traffic increase to justify a bold scheme of electrification, or a revenue of £75,000 per mile to warrant tube construction, we cannot tolerate such express omnibus and coach services as merely duplicate the railway service. This does not apply to road services of peculiar utility, or which ease rush-hour conditions on railways with congested tracks.

*Methods of Feeding Railways.*—Traffic may be diverted to railways by (1) raising the road fare rate, (2) widening the road service interval, (3) converging road services alongside railways, and (4) terminating services at suburban stations. Methods (1) and (2) cannot be very effective without unduly incommoding short-distance passengers, but very low long-distance fares could often be withdrawn with advantage to the essential railway service. Methods (3) and (4) are much more potent and need not impose undue inconvenience on the short-distance passenger.

If outer suburban road services terminate at suburban stations, passengers who would not otherwise bother to change vehicles will transfer to trains.

*Necessity of Subsidising Railways.*—Direct subsidising becomes necessary when the revenue is still insufficient, after having diverted all such road traffic thereto as is possible. It is being more widely recognised that it is neither possible nor desirable to expect railway passengers to meet the whole cost of providing expensive new railways, with their private right-of-way, and that it is better for the community at large that the burden be spread wider. Subsidies may come from: (1) A prosperous co-ordinated road transport service; (2) a Government subsidy or guarantee; (3) a municipal subsidy or guarantee, or (4) from special rate assessments on the district benefited thereby. In this country only methods (1) and (2) have been used.

### Conclusions.

The following summarises the conclusions to be derived from these articles, and assumes that capital is available at 5 per cent., and that reliable high-tension current is obtainable at 0·5d. per unit.

With more than thirty-four trains per day each way an electric service of equal speed is likely to be cheaper than a steam one.

With more than fifty to sixty trains per day each way, an electric service, of some 40 per cent. greater speed, may well be cheaper than a steam one.

Given thirty-four or more trains per day each way, a 40 per cent. faster electric service will rarely cost more than £500 more per mile of route annually, or, say, 6 per cent. of the total cost of the railway service.

Similarly, but with a 50 per cent. increase of slack-hour service, the cost will rarely exceed £1000 annually, or, say, 10 per cent. of the total.

With a 40 per cent. speed-up and a 100 per cent. increase of train mileage, the extra revenue required to meet the cost will be of the order of 25 to 30 per cent., with medium frequency services up to fifty-six steam trains per day, and of up to 50 per cent. with higher frequency services.

Post-war experience in London discourages expectations of a rate of traffic growth, with electric traction over a great area subject to intense road competition, of more than 3 per cent. per year.

Conservative electrification schemes, relating only to high-frequency lines, can be confidently advocated, but bold schemes entailing much increase of train mileage may have to be subject to some control of road competition.

A new surface electric railway, costing £200,000 per mile, demands a revenue of £25,000 to £30,000 per mile per year, and a population served of, say, 12,000 per mile, on a long line.

A new tube railway, costing £600,000 per mile, demands a revenue of £75,000 to £90,000 per mile per year, and a population served of, say, 40,000 per mile, on a long line.

A 4-mile surface line should serve a terminal population of not less than 60,000.

A 4-mile tube should serve a terminal population of not less than 150,000.

A high proportion of the operating expenses of modern railways is fixed, and the rate of fare is, therefore, bound up with the number carried. The average rate can vary from 1d. per mile to ½d. per mile on very busy lines.

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*L.M.S. Railway Figures.*—The writer is indebted to the London, Midland and Scottish Railway Company for figures provided by the courtesy of Mr. C. R. Byrom, Chief Operating Manager, showing the development of traffic on its London electrified lines. These are summarised in the Table XXI. Section A stretches out into a rapidly developing outer suburban residential area, but Section B is largely confined to highly developed inner suburbs subject to intense road competition. Observe:—

(1) Fair growth of ordinary traffic in A.

(2) Considerable growth of season ticket traffic in A.

(3) An average annual post-war gain in A of 8·3 per cent.

(4) No substantial and continuing growth of ordinary traffic in B.

(5) A post-war decline in season ticket traffic in B.

(6) No substantial change in total traffic in B.

(7) An average annual post-war gain on all L.M.S. lines for all traffic of 3·6 per cent.

(8) Pre-war totals greatly exceeded in A but not in B.

(9) Post-war average annual gains on all London trunk lines of 1·7 per cent.

The company points out that ordinary traffic—as distinguished from season ticket traffic—is especially susceptible to post-war depression and to road competition, and that it is especially desirable owing to its good load factor. The figures given in previous articles related only to Section A.

Table XXI.—*Millions of Passenger Journeys on London Electrified Lines—London, Midland and Scottish Railway.*

| Year. | Section A. | | | | Section B. | | | | All London trunk railways. |
|---|---|---|---|---|---|---|---|---|---|
| | Ordinary, &c. | Season. | Total. | Electric train miles, mln. | Ordinary, &c. | Season. | Total. | Electric train miles, mln. | |
| 1913 | 4·00 | 2·98 | 6·98 | — | 11·53 | 3·88 | 15·40 | — | 250 |
| 1921 | 7·74 | 5·22 | 12·96 | 0·785 | 9·52 | 6·75 | 16·27 | 0·971 | 324 |
| 1923 | 9·70 | 5·38 | 15·08 | 1·775 | 10·76 | 7·06 | 17·82 | 1·130 | 315 |
| 1925 | 10·64 | 6·66 | 17·30 | 2·025 | 10·95 | 6·39 | 17·34 | 1·186 | 319 |
| 1927 | 10·26 | 8·30 | 18·56 | 2·117 | 10·74 | 6·15 | 16·89 | 1·207 | 323 |
| 1929 | 12·34 | 9·21 | 21·55 | 2·245 | 10·48 | 5·92 | 16·40 | 1·237 | 346* |
| 1930 | 12·84 | 9·82 | 22·66 | 2·311 | 10·46 | 5·73 | 16·19 | 1·251 | — |
| 1931 | 12·40 | 10·20 | 22·60 | 2·372 | 10·30 | 5·30 | 15·60 | 1·256 | — |
| Increase, 1930 over 1913 | 220% | 230% | 225% | — | −9½% | 47% | 5% | — | 38%* |
| Increase, 1930 over 1921 | 66% | 88% | 75% | 195% | 10% | −15% | −4% | 29% | 7%* |

First column includes workmen's and cheap tickets. Includes steam train passengers. Section A: Euston, Broad-street, Watford Junction, &c. Section B: Broad-street, Earl's Court, Kew Bridge and Richmond. Section A electrified: Willesden to Queens' Park, 1915; Broad-street to Watford, 1917; Euston to Willesden, 1922. Section B electrified: Willesden to Earl's Court, 1914; Broad-street to Richmond, 1916.

## The Alsace Canal and Kembs Power Station.

The first section of the canal forming part of a plan to construct a lateral waterway from a point on the Rhine about 3 miles from the Swiss frontier to Strasburg has recently been completed and opened to traffic. The barrage across the Rhine is well advanced, and turbo-alternators are being installed in the Kembs power station. There is every prospect of the electrical supply being ready towards the end of the year, so that this important undertaking will be in operation within four years from the time it was started. The two main objects of the scheme are to ensure regular navigation on the Rhine at all seasons, and to utilise the difference in the water level between Basle and Strasburg of 108 m. for the production of energy equivalent to something like 900,000 horse-power. Whether the entire scheme will be carried through depends on circumstances, for parliamentary sanction will be required for the construction of the remaining seven sections, and in view of changes that have taken place in the situation generally, there may be less urgent need than formerly to push forward with the canal to Strasburg. The utility of the Kembs section is unquestioned, for it removes the most serious difficulty to Rhine navigation by enabling barges to avoid the Istein bar. This bar—indicated on the accompanying map—is a mass of rock over which the depth of water is being steadily reduced by the deepening of the river bed above it, which is thereby forming rapids that barges can negotiate only with extreme difficulty at certain times of the year, while at high water the velocity of the current affects considerably the economy of transport up to Basle. The avoidance of the Istein bar gives to the canal increased importance in view of the scheme which Germany and Switzerland have in hand for regularising the Rhine and connecting it up eventually with the Danube in order to create an uninterrupted waterway across Europe.

The scheme for the lateral canal was first proposed by Monsieur Koechlin in 1893, but it was only in 1923 that the Société des Forces Motrices du Haut-Rhin, which had been formed to promote it, obtained from the Swiss and French Governments the concession for the construction of the Kembs section. A new company, the Energie Electrique du Rhin, was organised to undertake the work of construction, with the aid of the Société des Grands Travaux de Marseille, Société Maison Fougerolle Frères, Société Générale d'Entreprises and the Compagnie d'Entreprises Hydrauliques et de Travaux Publics. The preliminary works were begun in 1928, and the excavation of the canal was started early in 1929. From the Swiss frontier the Rhine traverses an alluvial plain composed mainly of sand and gravel overlying, so far as concerns the area of the canal, a blue clay on rock. The alluvial ground holds water that flows to the river, and the excavations had to be carried down to depths in some places of 8 m. to 10 m. below the subterranean water level. Elaborate preparations had therefore to be made for dealing with this water. Wells were sunk in the canal at distances of 50 m., and a lateral concrete drainage canal was constructed to discharge the water into the Rhine below the Kembs station. Altogether 1000 kW were required to work the pumps for raising water from the canal, locks, and power station, and as the excavation continued the wells were deepened until they reached the impermeable clay or rock. The canal from the Rhine to Kembs is of trapezoidal section, 80 m. wide at the bottom and 150 m. wide at water level, with a maximum depth of 12 m. The length of the canal to the power station is a little more than 6 kiloms. (about 3¾ miles), excluding the short section from the power station to the river, which will be suppressed on the completion of the next section of the canal.

As the excavation was effected almost entirely in sand and gravel, with only a small quantity of rock to be removed, preparations were made to push it forward as rapidly as possible with the aid of a complete installation of high-duty machinery. On the Kembs section the machines had to remove

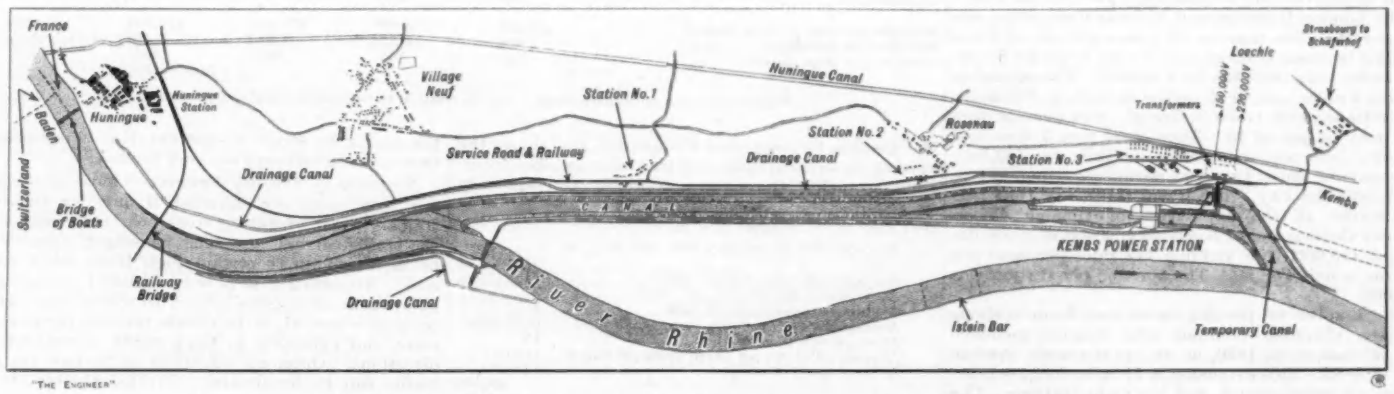


Fig. 1—Map of Part of the Alsace Canal and the Kembs Power Station

## ALSACE CANAL AND KEMBS POWER STATION

FIG. 2—VIEW OF DAM ACROSS THE RHINE AND ENTRANCE TO CANAL

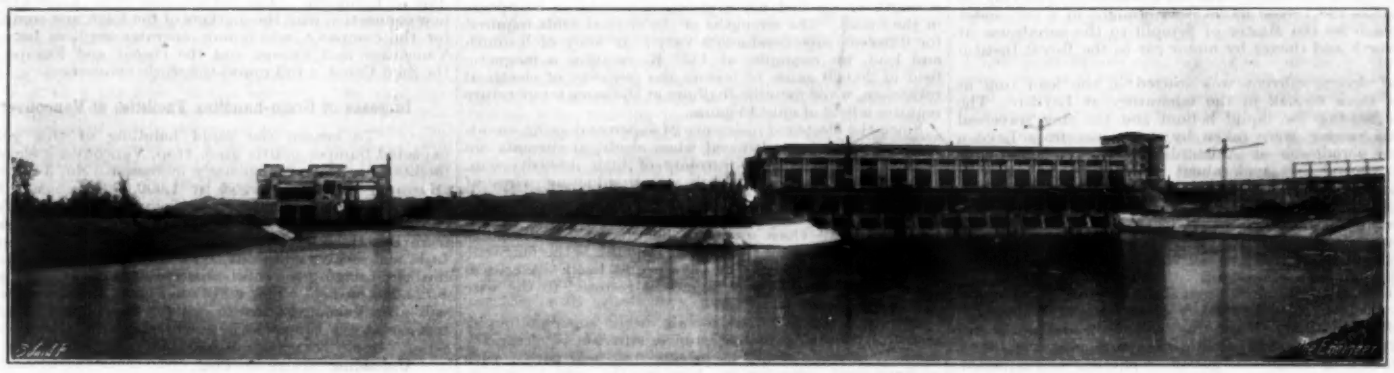

FIG. 3—LOCK GATES AND KEMBS POWER STATION

consists of a heavy steel frame on two bogies, with a mobile front carrying two pairs of vertical rollers, which grip under the heads of two rails. The mobile front is hinged and geared to give it a vertical and lateral movement. The rollers raise the track slightly and are offset to bend the light rails to the extent of the lateral displacement required. The machine is then pushed forward by a locomotive, when the rails take up the position given to them by the offset rollers. The efficiency of this machine is shown by the fact that it displaced three light tracks simultaneously, the sleepers of one track pushing the others sideways. Another similar machine for displacing the track and levelling dumps has a pivoting arm to which radial action is given by hand gear. The arm terminates in two pairs of rollers, which are adjusted under the head of one rail. The machine has an articulated frame carrying a large ploughshare, which is raised and lowered sideways. When pushed forward the ploughshare scrapes the surplus spoil down the side of the dump while the track is displaced nearer the edge. These machines were supplied by the Lauchhammerwerke A.G.

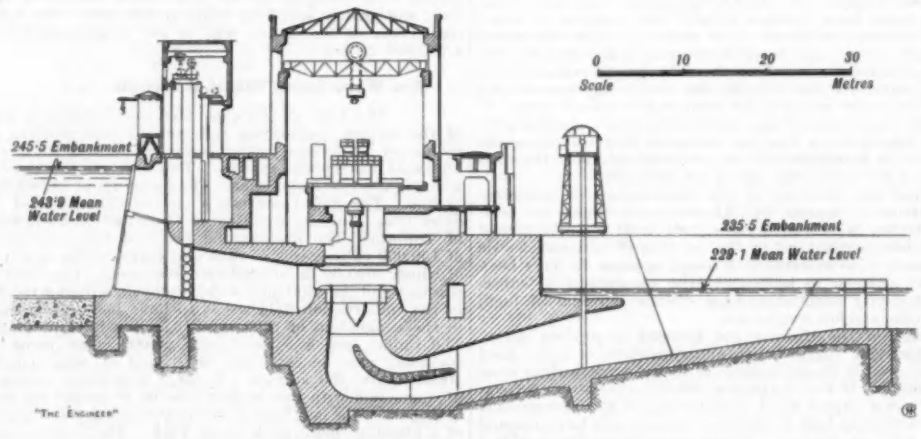


FIG. 4—CROSS-SECTION OF KEMBS POWER STATION

Except for the completeness of the preparations and the drainage arrangements, and the use in some cases of special machinery, there is little calling for remark concerning the excavation of the canal and locks, but the method of laying concrete along the sides of the canal was new. This process was carried out by means of a machine—Fig. 5, page 210—which performed all the operations of levelling, ramming, laying wire netting for reinforcement, and finally depositing the concrete. The machine is composed of a hut running on rails at the top of the bank, and containing an oil engine, mixer, and winding gear. From this hut a girder frame of large rectangular section extends to a vertical frame on rails at the bottom. The girder is set to the angle of the bank, and guides the various appliances for preparing the surface and laying the reinforced concrete. This machine laid 25 square metres of concrete an hour.

The two locks on the canal have lengths of 185 m. and 100 m., and a width of 25 m. The larger lock can hold comfortably one of the big paddle tugs employed on the Rhine and two 1200-ton barges. Fig. 6 shows the longer lock from the lower entrance, with a raised sill at the further end. The lock is filled from apertures along the bottom at each side, these apertures opening into galleries from the canal and being closed by valves. The sluice gates are counterweighted and are moved vertically by chains passing up over pinions in towers containing electric motors. An illustration of the plant used for concreting the locks is given in Fig. 7. Each machine is composed of a horizontal girder frame carried at one end on the upper railway track and joined at the other end to a vertical standard, 60 m. high, which runs on the lower track. At the extremities of the luffing jibs are runways for distributing the concrete over a wide radius. On the frame are two mixers having a total capacity of 50 to 75 cubic metres an hour. The machine requires about 230 horse-power for its operation. All the shuttering used throughout the works was of standard section, planed and oiled on the insides.

A cross section of the Kembs power station is shown in Fig. 4. It is situated close to the locks, and along the front a roadway is carried over the turbine tunnels, there being two tunnels for each of the six turbines. One or other of the tunnels is closed by balanced sliding gates, and when a turbine is stopped, the second tunnel gives free passage to the water, as well as to ice during the winter. The turbines will work under a maximum head of 16·6 m. of water, and the quantity of water passing through each turbine per minute will be from 153 to 187 cubic metres. The speed of the turbines will be 93·7 revolutions per minute. Their efficiency is declared to be 85 per cent. The alternators will produce three-phase current at 50 periods and 8800 volts, and the capacity of each will be 31,000 kVA. The vertical shaft has a diameter of 70 cm. and weighs 30 tons, while the weight of the rotor is 215 tons. The volume of air required for cooling is 40 cubic metres per second, while the usual provision is made for the automatic release of carbonic acid gas to replace air in the event of the temperature reaching a critical point. Two groups of turbo-alternators, supplied by the Société Alsacienne de Constructions Mécaniques and by the Alsthom Company, are being installed. These machines will be followed by three other similar groups, and finally by a group of Kaplan variable inclined blade turbines. When completed, the Kembs plant will develop something like 200,000 horse-power, and its maximum capacity will be 800,000,000 kWh a year.

The dam which is to raise the level of the Rhine by 7 m. in order to give the required head of water at Kembs is being constructed 500 m. below the upper end of the canal. This dam will increase the maximum depth of water at the barrage to 11·5 m. The work is being carried out by the Energie Electrique du Rhin for the State. Its execution was delayed by difficulties arising partly out of the necessity for the town of Basle reconstructing its drainage system, which otherwise would have been flooded by the high water, and partly by the somewhat arduous conditions imposed by the Commission Centrale de la Navigation du Rhin. The dam is being constructed of masonry on a reinforced concrete foundation in compact blue clay. There will be five Stoney gates, each 30 m. wide. The sill between the piers is 30 m. wide and 28 m. deep. Fig. 8, p. 210, shows the construction of two piers, and is reproduced from a photograph taken at the beginning of this year. It is hoped to complete the dam by the end of the year, except for the closing of the central passage which has had to be left open for navigation. The two gates on each side will hold up sufficient water for the two initial turbo-alternators at Kembs, and the central foundation, sill, and gate will be completed by the time the other turbo alternators are ready for working.

The extensive transformer equipment at the side of the power station is well advanced, and will supply current at 150,000 and 220,000 volts. This current will be distributed over both sides of the Vosges, and may eventually be joined up with the supply to Paris. The station forms part of the great national scheme for linking up the hydro-electric mains with mains from power stations at the northern collieries.

# Electrical Conductivity of Metals at the Lowest Temperatures.*

Through the kindness of Colonel The Master of Sempill and Professor W. H. Keesom, who succeeded Professor Kammerlingh Onnes in the Directorship of the Cryogenic Laboratory in the University of Leyden, I am able to show my audience this evening some liquid helium and a persistent electrical current in a ring composed of lead in the superconducting state. This is the first time that liquid helium and an electric current in a metal in the superconducting state have been exhibited in England.

To-day a quantity of helium was liquefied by Professor Keesom in the Cryogenic Laboratory at Leyden. The helium was collected in a large glass Dewar flask supported in a second Dewar flask of glass containing liquid air. These two were supported in a third metallic Dewar flask also filled with liquid air. A small ring of lead, about 2·5 cm. in diameter and about 3 mm. in cross section, was placed with its plane vertical in the bottom of the inner flask immersed in the liquid helium. At the temperature of liquid helium lead is superconducting, and in the present instance an electric current of about 200 ampères was induced in it by an external magnetic field.

Mr. Flim, Professor Keesom's assistant, carrying in his hands the Dewar flasks, was brought in a two-seater aeroplane by the Master of Sempill to the aerodrome at Hanworth and thence by motor car to the Royal Institution.

The electric current was started in the lead ring at about three o'clock in the laboratory at Leyden. The flasks bearing the liquid helium and the ring traversed by the current were taken by motor car from Leyden to the aerodrome at Amsterdam where the aeroplane flight started. It took about three hours to fly from Amsterdam to Hanworth, and as it is now past nine o'clock we see that the electric current in the ring has persisted for over six hours. That an electric current is traversing the ring is made evident to all present by the effect its magnetic field exerts on the magnetometer on the table now before you.

It is over one hundred years since Faraday in collaboration with Sir Humphry Davy in the Royal Institution, liquefied chlorine. This was an epoch-making event, for it led to a succession of similar experiments in the same laboratory in which one gas after another was liquefied. With the liquefaction of these gases lower and lower temperatures became available for research. With liquefied oxygen temperatures as low as −183° C. can be reached. With liquefied nitrogen −196° C., with liquefied hydrogen −262° C., and with the large supplies of helium now available it is comparatively easy with the liquefaction of this gas to reach a temperature of −272° C., or 1° Kelvin, *i.e.*, one degree above the absolute zero.

The production of low temperatures by the use of liquefied gases has an important bearing on the solution of the problem of the passage of electricity through metals, a problem which, for nearly 150 years has remained unsolved either by the experimentalist or the theoretical physicist. Experiments by Dewar and Fleming in 1893 on the electrical conductivity of metals cooled to very low temperatures by means of liquefied gases, including air and hydrogen, suggested that the electrical resistances of all pure metals would vanish at the absolute zero of temperature.

In 1911, however, Kammerlingh Onnes, at Leyden while carrying out researches at low temperatures with the aid of liquefied helium, discovered that mercury, when cooled down and solidified with liquid helium, suddenly and abruptly at about 4·2° K. became what is now designated as a superconductor of electricity. At temperatures below 4·2° K. mercury offers no measurable resistance to the passage of a current. Currents of electricity started in a ring of mercury in the superconducting state will continue apparently undiminished in intensity while the metal is in that state. The duration of these persistent induced ring currents is limited only by the length of time the cooling agent, liquid helium, will last. Other metals that exhibit this superconducting property if made sufficiently cold are lead, tin, indium, gallium, thallium, tantalum, titanium and niobium. The transition temperature for the passing of a metal from the ordinary conducting to the superconducting state is not a constant, but varies with the metal. For mercury it is 4·2° K.; for lead, 7·2° K.; tin, 3·72° K.; tantulum, 4·5° K.; thallium, 2·39° K.; indium, 3·4° K.; gallium, 1·07° K., and niobium, 8·2° K. Some alloys and chemical compounds of the metals also exhibit the superconducting phenomenon. Copper sulphate, for example, does so, though neither of the constituent elements is a superconductor. The nitrides and carbides, borides and silicides of several of the metals, such, for example, as molybdenum, tungsten, tantalum, zirconium, and niobium, are also superconducting at sufficiently low temperatures.

The addition of metals of the bismuth group to superconducting metals has been found, speaking generally, to raise their transition temperature. Bismuth added to lead raises the transition temperature from 7·2° K. to 8·8° K.; carbon raises that of niobium from 8·2° to 10·5° K. Gold alloyed with bismuth becomes superconducting at 1·94° K., whereas neither constituent alone becomes superconducting even at the lowest temperatures obtainable.

Recently, the speaker, in collaboration with his associates, J. F. Allen and J. O. Wilhelm, made a study of various alloys of the Ag-Sn, Au-Sn, Au-Pb systems. Three outstanding features characterise the results. First, in alloys with the superconducting elements it was observed that gold and silver produce an effect on the transition temperature opposite to that produced by bismuth, antimony and arsenic. When one observes alloys containing the latter metals one finds usually a pronounced elevation of the superconducting temperature, while in alloys with gold and silver one finds an equally pronounced depression of the superconducting temperature. Secondly, it was noted that a binary alloy system composed of a superconductor and a non-superconductor does not necessarily have a unique transition temperature. Thirdly, it was found that with the alloy systems, Ag-Sn, Au-Sn, Au-Pb, the transition temperatures were higher for eutectic mixtures than for chemical compounds of the two metals constituting the alloys. The data compiled in the table will serve to illustrate these points. The element silver and the compound $Ag_3Sn$, it will be seen, have not been found to be superconductors at any temperature reached up to the present:

*Tin-Silver Alloys.*

| Substance. | Mixture. | Percentage of tin. | Transition T. |
|---|---|---|---|
| Tin .. .. .. .. | Pure .. .. .. | 100 | 3·76° K. |
| Ag-Sn .. .. .. | Eutectic alloy .. | 96 | 3·52° K. |
| $Ag_3Sn$ .. .. .. | Eutectic alloy .. | 50 | 3·57° K. |
| $Ag_3Sn$ + 3% Sn .. | Mixture .. .. | 30 | 2·3° K. |
| $Ag_3Sn$ .. .. .. | Compound .. .. | 27 | — |
| Ag .. .. .. .. | Pure .. .. .. | 0·0 | — |

The application of mechanical stresses such as those of torsion and tension raise the transition temperature of a superconducting metal, but the application of a magnetic field delays the appearance of superconductivity and causes it to appear in a metal at a lower temperature than normally.

If a metal in the superconducting state be subjected to a gradually increasing magnetic field, a critical field strength is reached when electrical resistance reappears in the metal. The strengths of the critical fields required for different superconductors vary; an alloy of bismuth and lead, for example, at 1·2° K. requires a magnetic field of 20,000 gauss to restore the property of electrical resistance, while metallic thallium at the same temperature requires a field of only 15 gauss.

Since the electrical resistance of superconducting metals is zero, no heat is produced when electrical currents are passed through them. Currents of high intensity can, therefore, be passed through superconducting wires of small diameter without melting them. Electric currents of more than 1000 ampères have been so obtained in wires of small cross section. The factor that imposes a limiting value upon the current strength is the magnetic field set up in the wire by the current itself. A critical value is reached when resistance is restored to the wire by the magnetic field.

Owing to the fact that metals in the superconducting state have no electrical resistance, currents of electricity induced in rings of metals in this state will persist with undiminished intensity so long as the metals remain superconducting. So far it has been found impossible to detect with instruments of precision any diminution in the intensity of ring currents in superconductors even after the lapse of a period as long as thirteen hours.

Recently some experiments were carried out by the writer, J. F. Allen and J. O. Wilhelm on the intensities of persistent currents of electricity induced in rings, having the same dimensions, of lead, tin, and tantulum brought into the superconducting state by the use of liquid helium. The currents in the rings were induced by the magnetic field provided by electric currents established in a circular coil of wire placed in turn coaxial with and close to each of the superconducting rings. It was found that for the weaker magnetic fields equal changes of flux produced currents of equal magnitude in each of the three superconductors. The magnitude of the persistent current developed depends not on the substance of the superconducting ring, but only on its dimensions and on the magnitude and form of the inducing magnetic field.

The case of tin is very interesting, since the values of the current in it agree with those of the current in the others only up to fields of about 25 gauss. For inducing fields higher than this the strength of the persistent current dropped off. Above this point, then, part of the ring must have been in a field, the strength of which had reached the critical value where resistance reappeared —that is, an inner layer of the ring must have become non-superconducting. As the field was increased above this point, one can suppose the outside superconducting portion of the ring became thinner and thinner until the whole ring became non-superconducting. Incidentally, this demonstrates that the magnetic field traversing the coil is not homogeneous, but possesses a gradient from the axis of the coil to the edge of the coil itself.

Since the discovery of the phenomenon of superconductivity in metals by Kammerlingh Onnes in 1911, researches in this field have been until recently almost invariably carried out by the use of unidirectional electric currents. No systematic attempt appears to have been made hitherto to investigate the phenomena of superconductivity with alternating electric currents of high, medium, and low frequencies.

Some of the theories put forward to explain superconductivity suggest that an orientation of some kind is involved in the production of the superconducting state in metals. If this suggestion should prove to be correct, one would expect some modification of the phenomenon for currents of high frequency. It need only be mentioned that all "orientation" effects are considerably modified in an oscillating field with a time-period of the order of, or less than, the "time of relaxation" of such orientation. A well-known example is that of the dielectric constant which rapidly diminishes in value for very high-frequency electric fields. As to "relaxation times," it will be recalled that in the case of ice, experimental evidence shows that the relaxation time is of the order of $10^{-6}$ sec. at 0° C. and rapidly increases as the temperature is lowered. It would not seem unreasonable then to expect to find "relaxation times" exhibited by metals in the superconducting state provided one used in one's experiments alternating fields of suitable and adequate frequencies. A short time ago an investigation was initiated in this direction by the speaker and through a set of researches carried out successively with the collaboration of a number of associates, *i.e.*, Niven, Wilhelm, Burton, Allen, Smith, McLeod, and others, the work recently culminated in the discovery that such metals as lead, tin and tantalum can be made to exhibit, when in the superconducting state, characteristic phenomena that point to their possessing "relaxation times" roughly of the order of $10^{-7}$ sec. or $10^{-8}$ sec.

* Abstract of lecture delivered before the Royal Institution of Great Britain by Professor J. C. M'Lennan, June 3rd, 1932.

# Canadian Engineering News.

### Ontario's Future Power Supply.

Hydro-electric power available to the Ontario Hydro-Electric Power Commission will be almost doubled with the completion of the St. Lawrence seaway project. For the year ending October 31st, 1931, the Ontario system generated or purchased a total of 1,575,171 horse-power, of which a normal capacity of 1,183,665 was borne by its own generating plants. The treaty between Canada and the United States gives Ontario 1,100,000 H.P. out of the 2,200,000 H.P. to be generated in the international section of the St. Lawrence River. Added to the 1,575,171 H.P. now available, this would make a total of 2,675,171 H.P. some years hence. This total, however, does not include additional horse-power to be developed in other parts of Ontario. The Commission has contracted to buy 100,000 H.P. to be developed at the Abitibi Canyon plant in Northern Ontario. Other plants may bring the total capacity well past the 3,000,000 mark when power becomes available from the St. Lawrence project.

### New Canada-China Service.

A regular freight and passenger service from Vancouver and other Pacific Coast ports to Shanghai and Hong Kong is being established by the Danish East Asiatic Company. The service will give Vancouver a new connection with the markets of the East, and complete for the company, which now operates services between Vancouver and Europe and the Orient and Europe *viâ* the Suez Canal, a full round-the-world connection.

### Increase of Grain-handling Facilities at Vancouver.

To ensure the rapid handling of this year's expected bumper prairie grain crop, Vancouver's elevator facilities are to be immediately increased. No. 3 elevator (Burrard) will be enlarged by 1,000,000 bushels. This plant is owned by the Harbour Commission. Its present capacity is 1,650,000 bushels. No. 1 elevator, leased from the Harbour Commission by Vancouver Terminals, Ltd., will receive additional bins to accommodate 475,000 bushels, bringing the total capacity of this elevator up to 1,725,000 bushels. This additional grain storage capacity will give Vancouver the means for handling 17,703,000 bushels at one time.

### Unloading Bridge for Coal.

The coal-handling facilities at the Port of Montreal are being steadily improved to meet the requirements of the trade, which shows signs of continual expansion. The most recent development is the design and erection of a rope trolley unloading bridge for the Scotch Anthracite Coal Company, Ltd. This bridge will be erected on the 1000ft. wharf built by the Harbour Commissioners, east of the Canadian Vickers' shipbuilding plant, and should greatly expedite the discharge of ocean steamers. By means of this unloading bridge, it will be possible for coal to be transferred to lake vessels direct from the storage piles, to railway cars, or to the company's trucks and wagons for local delivery.

### Tunnel Driven Under Vancouver.

The new Canadian Pacific Railway tunnel at Vancouver, connecting the False Creek yards with tracks on Burrard Inlet waterfront, was put into operation on July 17th. The tunnel, which is lined with concrete throughout, is 4600ft. long, 29ft. high, and about 23ft. wide, and is single tracked, with rock ballast. The project, which was begun in 1931, will eliminate a number of dangerous level crossings in the down-town section of the city, and greatly speed up traffic in the area. The estimated cost of the project was in the neighbourhood of 1,750,000 dollars.

### New Water Supply Tunnel at Toronto.

The City of Toronto has just completed one of the largest engineering and construction projects in its history. This undertaking is the basic unit in the city's duplicate waterworks system. Two and one-third years were required for its building. The cost is about 14,000,000 dollars. The unit comprises a concrete-lined tunnel 10 miles long, built by the Rayner Construction Company, of Toronto. The undertaking involved the excavation of 150,000 cubic yards of rock and earth, in the removal of which 500,000 lb. of explosive were used. Considering this fact and that 600 men were employed, almost a record in the construction field seems to have been established in the completion of the work without a fatal accident. The tunnel, which is lined with 80,000 cubic yards of concrete, runs beneath the city, lying at some points 200ft. below the surface. A large additional contract in connection with this project is to be let before the end of August. The new work to be undertaken is the erection of a filtration plant at Victoria Park. The construction includes an administration building of concrete, steel, and brick; a reinforced concrete covered reservoir of 12 million gallons capacity, and two rows of twenty concrete filter beds, each 68ft. by 35ft.

### Natural Gas Developments.

It is announced that the North-Western Utilities, Ltd., of Edmonton, Alberta, while drilling for natural gas in the Kinsella field, south-west of Edmonton, has struck a large flow in the Harvey No. 1 well. The new producer is reported to have a flow of 7,600,000 cubic feet per day. The well was the first on the 1932 programme to be drilled in the Kinsella field. Only recently the company brought into service well No. 24 in the Viking field with a flow estimated at 11,000,000 cubic feet per day, the largest in that field to date. The company undertook a programme of development this year embracing two wells in each of these fields for the strengthening of the gas reserves supplying the City of Edmonton. The Viking field, hitherto the main source of supply, appears to have a rival in the Kinsella area on the basis of the results attained in the Harvey No. 1 well. The programme will continue with the drilling of Harvey No. 2 well, which is to be undertaken immediately.

## Railway and Road Matters.

THE reconstructed station at Marble Arch, referred to herein on August 12th, has two escalators of an improved kind. They are 70ft. long and travel at a rate of two miles an hour, or twice as fast as the earlier escalators.

THE Drumm battery rail-car, to which reference has occasionally been made in our columns during the last year or more, runs on the Great Southern Railways of Ireland. The Great Northern Railway (of Ireland) is now experimenting between Dublin and Howth, with an oil-engined rail-car.

RAILS are loaded into wagons by gangs of men lifting them off the ground. The *Great Western Railway Magazine* for August describes an arrangement whereby this is now done by drawing the rails, by a wire rope attached to an engine, end on to the wagon. Six men can now do the work that hitherto has required a gang of men.

ARRANGEMENTS have been made at Portrush to celebrate in August of next year the jubilee of the Giant's Causeway Electric Tramway. According to our own records, that railway was opened on January 18th, 1883, and runs between Portrush and Bushmills. Volk's Railway, on the beach at Brighton, was opened on August 2nd of the same year.

THE Ministry of Transport railway statistics for May have recently been issued as a Stationery Office publication, price, post free, 2s. 7½d. They show, when compared with the corresponding period of 1931, a decrease of 6·2 per cent. in the number of passenger journeys and a drop of 10·9 per cent. in the receipts. The passenger train mileage rose by the small figure of 0·7 per cent. The tonnage of freight decreased by 10·7 per cent., and the freight receipts by 12·9 per cent. The freight train mileage was brought down by 10 per cent., and the average train load fell from 124¼ to 118¾ tons.

THE superstructure of the Wichnor Viaduct, carrying the main line from the North and Midlands to West of England over the confluence of the rivers Trent and Tame between Burton-on-Trent and Tamworth, which is of twenty-six spans and about 1240ft. in length, has been strengthened to allow the latest types of L.M.S. engines to work between Derby and the West of England. The viaduct was originally built of timber in 1839, and was rebuilt in wrought iron in 1879. The reconstruction just completed has been carried out under the supervision of Mr. E. H. d'E. Darby, L.M.S. divisional engineer at Derby.

THE Railway Returns for 1931 show that on December 31st of that year the capital expenditure of the British railways amounted to £1,245,779,006, as compared with £1,234,037,483 at the end of 1930, an increase of £11,741,523. The gross receipts from railway working, *i.e.*, exclusive of such ancillary businesses as docks, steamers, hotels, &c., amounted to £170,158,536, as against £184,836,382 in 1930, a decrease of £14,677,846. The expenditure was £136,858,604, as compared with £147,595,684, a saving of £70,737,080. The principal economies were £2,302,048 in locomotive running expenses, £3,485,575 in traffic expenses, and £4,247,855 in the maintenance of way and works and of rolling stock.

THE recommendation of Lord Trenchard, the Chief Commissioner of Police, in his annual report to the Home Secretary, that "London should advance in the matter of traffic signals," as "the introduction of traffic signals is desirable from the point of view of facilitating the flow of traffic in streets where traffic is heavy, at the same time relieving police for other work more in keeping with their proper duties," reminds us that street signals were tried in Paris in 1913, but were abandoned. Their first permanent installation was on Fifth-avenue, New York, in 1918, followed by a revival in Paris in 1923. Some were fixed in Berlin and Hamburg in 1926, and they were first tried in this country at Wolverhampton in the same year.

A SOURCE of economy in public administration, from time to time now advocated, is the abolition of the Railway and Canal Commission. That judicial body was set up, as a result of the report of the Select Committee of 1872 on the subject of railway amalgamations, by the Railway and Canal Traffic Act, 1873, to take over powers vested in the Board of Trade and/or the Court of Common Pleas to receive and deal with complaints. At first known as the Railway Commissioners, its title was changed to that borne to-day, and its powers greatly increased by the Railway and Canal Traffic Act, 1888. It is to-day urged that a good deal of the work of the Commission is done by the Railway Rates Tribunal. That may be so, but the Tribunal has not the legal standing of the Commission, and a fact to be remembered in that connection is that when the Ministry of Transport Bill was brought in in 1919 it was proposed that the Railway and Canal Commission should be appointed by the new Minister. That was not only successfully opposed, but words were inserted in the Act definitely stating that the Minister had nothing to do with the appointment of members or with the procedure of the Commission.

DURING the three months ended on December 31st last the Assistant Inspecting Officers of the Ministry of Transport held fifty-three inquiries into the more serious accidents to railway servants, of which sixteen were fatal cases. In eight of the latter it was considered that the deceased man showed a want of care and that, in three, some other servant was to blame; the remaining five were thought to have been due to misadventure. A case that shows how the most experienced is liable to err is reported from County School, on the L. and N.E.R. A bridge had to be demolished and the chief permanent way inspector was walking along the line, in the company of the telegraph inspector, to visit the work. The line is single tracked and paralleled by another single track. They walked along the line which was on their right, and that fact, in the opinion of Mr. J. L. M. Moore, suggests a subconscious notion in their minds that they were on a double track and consequently, by force of habit, were attempting to walk facing the traffic. The same feeling probably accounted for their failure to respond to the whistle of a train behind them, with the result that the permanent way inspector was knocked down and killed. The other man was younger and more agile and jumped clear.

## Notes and Memoranda.

ACCORDING to Professor Inglis, of Cambridge, the tensile strength of the spider's web is 560 tons per square inch, and with a material of this strength a bridge could be made across the English Channel from Dover to Calais in one span.

IN the Nuneaton district it has been found that in a total weight of household refuse collected of just over 3000 tons, there were about 180 tons of metal, 145 tons of bones, and 1000 dozen bottles. Nevertheless, the resultant cinder from the incinerator is said to make excellent foundation for turf.

PENDULUM observations by the Canadian Dominion Observatory, Department of the Interior, show that the mountains of British Columbia are buoyed up by abnormally light material, extending down into the earth's crust for about 60 miles. The excess of gravity revealed by the pendulum on the prairies is believed to be due to an extensive underground ridge of abnormally heavy rock.

IT is noteworthy that during his recent Transatlantic flight, Mr. Mollison did not take the shortest route possible, which would, of course, have been over a great circle. Instead, he followed a course, mapped out by the Automobile Association, that permitted an immediate bearing to be made on his objective without any intermediate change of bearing. The pilot was consequently saved from any navigational calculations during the trip.

A VERY unusual power plant is being established near Bradford, New York, where 10,000 horse-power of engines driven by natural gas is to be interconnected with water turbine plant working under an effective head of 385ft. During such time that the gas engines are not fully loaded they will be used to pump water up into a natural lake, artificially increased by a dam, to supplement the power supply during peak loads by being utilised in water turbines.

As a result of numerous tests on the magnesium base alloys a patent taken out by the American Magnesium Corporation of Pittsburg states that the following composition has been selected as having an exceptionally good combination of casting and corrosion resisting qualities, together with satisfactory mechanical properties:—Tin, 6 per cent.; cadmium, 1 per cent.; zinc, 1 per cent.; manganese, 1 per cent.; and magnesium, 91 per cent. It is stated that these magnesium alloys containing tin are especially useful for casting purposes, and may be subjected to various heat treatments.

IN the course of a paper at the fortieth annual meeting of the Mining Society of Nova Scotia, held at Baddeck, N.S., recently, Mr. A. F. Cagney said that the average energy taken by electric coal cutters was 0·4 to 0·5 kW-hour per square yard undercut; consumption varies from 0·2 kW-hour in very free cutting material to about 1·0 kW-hour in the hardest coal, the consumption being directly affected by the tension of the chain, its construction and the condition of the cutter bits. In many instances the removal of a few bits and a realignment of the others will not reduce the cutting time appreciably, but will show quite a marked improvement in the quantity of round coal obtained from the holings. Superfluous picks merely churn the cuttings.

ACCORDING to Mr. J. N. Waite, the city electrical engineer of Hull, gas lighting is definitely more expensive than electric lighting for public services. This condition is not necessarily caused by an unduly high price being charged for gas, as in some instances it is almost given away, but the cost of operation, maintenance, and cleaning is of necessity higher than that of an electric installation. Gas street lighting can be maintained at a high standard, but this is only possible at very great expense and with frequent cleaning. The claim is sometimes made that the light output of a gas mantle does not fall throughout life, but the fact remains that in a short time the reflectors become permanently discoloured, the gas burner requires frequent attention, and in the older types of lamps a considerable amount of burner deterioration is noticed. Illumination readings taken in London show that the light given by burners and mantles as found in service in gas lanterns can show a falling off of as much as 63 per cent. from the light given by the same sources when burners are clean and mantles new. It has been estimated that to maintain a system of electric street lighting with solar clocks and 10,000 posts, requires thirty-seven men for weekly cleaning, &c., whilst with the corresponding gas system fifty men are required. The maintenance of a gas system would cost £6825, as against £5050 10s. for the electric system.

ONE of the interesting features in connection with the construction of the Hoover Dam will be the artificial cooling of the mass concrete, which will be done in order to speed up the work as much as possible. The design of the dam is such that under ordinary methods of procedure the heat would be dissipated too slowly, and it is estimated that the dam, with its 3,400,000 cubic yards of mass concrete, would take many years to construct unless some artificial cooling method was employed. The specification, according to *Municipal Engineering*, requires that after any portion of the concrete in the dam (and tunnel plugs) has set for a minimum period of six days it shall be cooled by removing the excess heat above 72 deg. Fah., which is to be done by circulating water of requisite coolness through the concrete by means of a system of pipes, involving the provision and operation by the contractor of a complete refrigerating plant. To carry out this scheme there will be needed a network of 2in. piping, aggregating 800,000 lineal feet, or roughly 150 miles, which will be embedded in the concrete and will remain a permanent part of the dam structure. When poured, the concrete will have a temperature between 40 deg. and 100 deg. Fah., and the average temperature rise that will result from the setting of the concrete will be 40 deg. above that at which it is placed. The amount of heat that will have to be removed is about 700 B.Th.U. per degree per cubic yard of concrete. In the construction of the dam time is the essence of the contract, and the recommendation to introduce artificial cooling has been made by the U.S. Bureau of Reclamation. A considerable amount of interest attaches itself to the undertaking.

## Miscellanea.

A PLUMBERS' museum is to be opened in Newcastle.

A TWIN-WAVE broadcasting station is to be built by the B.B.C. at Droitwich. It will be of 100 kW.

AN order, stated to be worth over £10,000, has been placed with a British firm for aircraft material by the Persian Government.

THE Corporation of Glasgow is to be advised to proceed with the scheme of constructing a fixed high-level bridge over the Clyde at Finnieston.

WORK has been started on the underground railway system of Moscow, and it is anticipated that by 1936 as much as 71 miles of tunnel will have been completed.

A CARGO of washed Turkish coal has been received from Heraclea at Oran in Algeria. The c.i.f. price is stated to be 14s., some 32 per cent. of which represented freight charges.

THE old blast-furnace plant at Wellingborough is being dismantled and is to be replaced by two new furnaces supplied by Head, Wrightson and Co., of Thornaby-on-Tees.

THE Bluff Lighthouse at Natal is to be illuminated by electricity instead of by oil as hitherto. The change will increase the power of the light from 150,000 candle-power to three million candle-power.

THE total British coal exports to Canada for the first seven months of 1932 amounted to 769,000 tons, compared with 365,000 tons for the corresponding period of 1929. The greater proportion of this coal was anthracite.

FOR the first time in the history of the Commonwealth of Australia the official lists of telegraphic addresses are to be published, and the contract to publish them throughout the world has been secured by Business Dictionaries, Ltd.

THE repairs to Lincoln Cathedral, which have been going on for ten years, have been completed. The timber work at Chequers, the Prime Minister's country residence, which was badly attacked by the death-watch beetle, has also been renewed.

THE water tower which is now being built at Great Yarmouth is, it is claimed, the largest of its type in this country. It is of reinforced concrete and is 162ft. high, with a capacity of 784,000 gallons. Its construction, when completed, will have occupied about ten months.

A RATHER novel towing feat has just been carried out round the West Coast. A steam accumulator made by Cochran and Co., of Annan, was launched into the river Annan. It was provided with ballast and was towed right round to Gravesend, a distance of 1000 miles, in five days.

THE magnetic disturbances which have presented a serious problem in connection with the Hudson Bay shipping route will be studied during the winter by a party of scientists stationed at Chesterfield Inlet, which is situated within the realm of the most violent magnetic disturbances.

A RUSSIAN expedition, reinforced by some German mining engineers, has gone to Spitzbergen with the object of exploiting the coal resources there. It is said that in the Green Harbour district alone there are some 100,000,000 tons of coal. The intention is to produce about 400,000 tons of coal a year.

THE papers presented in the Symposium on Steel Castings, held at the recent annual meeting of the American Society for Testing Materials, in co-operation with the American Foundrymen's Association, are being reprinted in a special volume, with their discussions. The volume will comprise about 250 pages, and it is expected that distribution will commence about October 1st.

THE Commercial Counsellor to H.M. Embassy at Buenos Aires reports that, according to a Decree of the Argentine Government, dated June 23rd, 1932, the Department of Navigation and Ports has been authorised to proceed with the construction of an inland port at Campana, with available funds amounting to 319,303 dollars (paper). Campana is a town of about 20,000 inhabitants on the river Parana, 50 miles from Buenos Aires.

RAPID progress has been made with the Beauharnois power canal, and the work of filling and testing has been started. It is expected that the water level will be raised sufficiently high by the end of this month to permit operation of the power-house at Melochville, Lake St. Louis. This plant has a capacity of 200,000 H.P., and September will be devoted to testing and tuning up the machinery, so that by October 1st the company will have its first power ready for delivery as contracted.

THE whole area served by the Clyde Valley Electrical Power Company, extending to over 1000 square miles, was changed over during one week-end recently and will now have a standard frequency of 50 cycles. The work has been carried out free from interruption of supply or irritation or hardship to customers, and without litigation of any kind. The work was started in March, 1928, and the first machine was changed over in November, 1929. During operations 13,500 motors were changed, equal to 220,000 horse-power, and also eighty rotary converters, equal to 44,068 horse-power, while approximately 80 miles of cable were laid.

FREDERICK BAYLIS BROWN, a prominent consulting engineer of Montreal, was accidently killed at his summer home, Lac Ouareau, on August 6th, being struck by the propeller of a seaplane which was landing on the shore. He was born in Montreal in 1881 and graduated at McGill University. He became associated with many prominent enterprises, more particularly in the field of hydro-electric development. Mr. Brown designed and supervised the new street lighting system for the town of Mount Royal Que., and one of his latest activities was as consulting engineer to the Royal Commission investigating the Ontario hydro-electric power system. He was a member of the Engineering Institute of Canada and various other professional organisations.

# CONSTRUCTING THE ALSACE CANAL

(*For description see page 206*)

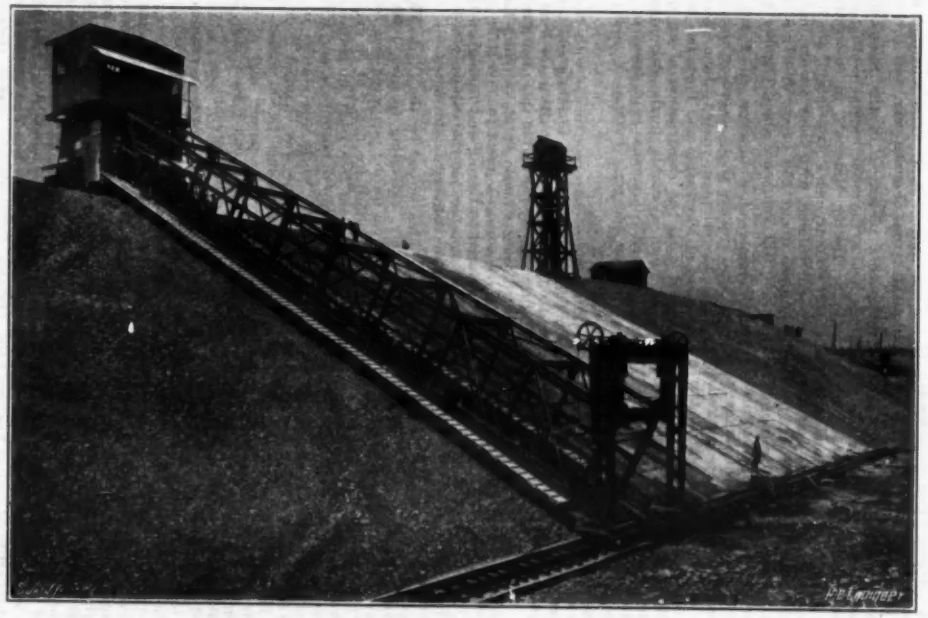

FIG. 5—CONCRETING MACHINE

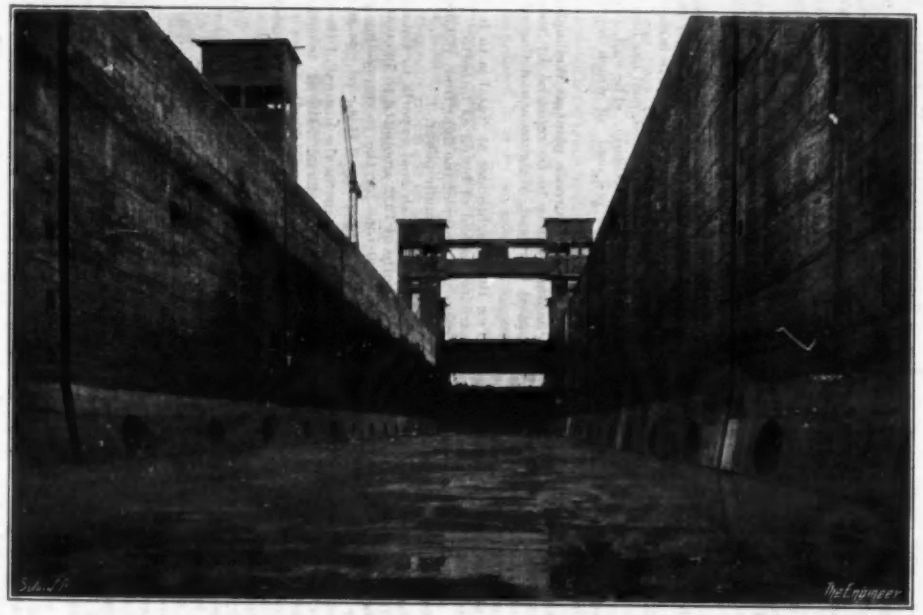

FIG. 6—THE LARGER LOCK

FIG. 7—PLANT CONCRETING THE LOCKS

FIG. 8—CONSTRUCTION OF DAM

# The Engineer

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### The Metallurgist.

THE AUGUST NUMBER OF THE MONTHLY METALLURGICAL SUPPLEMENT TO "THE ENGINEER" ACCOMPANIES THIS ISSUE.

### DEATH.

On August 22nd, at Kilmacolm, Renfrewshire, WILLIAM ARTHUR COULSON, Director of Mavor and Coulson, Ltd., Glasgow, and Chairman of Creed and Co., Ltd., Croydon.

### HOURS OF WORK.

THE announcement was made a few days ago that the Italian Government had called, for September 21st, a special meeting of the Governing Body of the International Labour Organisations to consider the question of the hours of work in industry. It is also reported that a five-day week, or an equivalent shortening of the working day, is regarded by the U.S. Government as the best measure for coping with the unemployment problem. These actions taken by two independent Powers at the same time cannot fail to affect other countries, and to direct close attention to a problem which has hitherto been allowed to find its own solution through the operation of *laisser faire*. In the course of a century hours of labour have been reduced, in round figures, by over forty per cent. But in no case has the reduction been brought about, in any stage, in obedience to a logical principle, to increase employment. In the engineering industry, to take one example, it was a specific part of the agreement that the 12½ per cent. reduction of hours should not be accompanied by a corresponding reduction in output. The change was made not with the object of increasing the number of employees, but because the means of production had so improved that the same number of men could do in less time the same amount of work as before. The objective, adumbrated by the actions of the Italian and United States Governments is quite different; the purpose is to reduce the number of hours which each operative may work in order that more may be employed. The action at the recent York meeting of the Federation of Shipbuilding and Engineering Trades Unions in unanimously supporting the movement for a forty-hour week has the same object.

Sooner or later this question will demand universal consideration, and, even at this relatively early stage, we suggest to employers that they should depart from the *non possumus* attitude which they have hitherto adopted and prepare themselves to debate calmly and logically the *pros* and *cons* of a movement which may prove to be one of national necessity. It is now fairly generally recognised that in this country under present labour conditions, but with factories working to capacity, there will always be unemployment in the neighbourhood of 7 per cent. of the industrial population, or, roughly, one million persons. It may be taken that a margin of unemployment—mostly temporary—of 2 per cent. is inevitable, so that the problem is to find constant employment, in flourishing times, for 5 per cent. more persons than there is, now, any great probability of employing. If the conditions were ideally simple, this requirement could be met comfortably by the adoption of the five-day week as suggested in America. Unfortunately, such a simple solution presents considerable difficulties when an attempt is made to apply it. It implies, in the first place, an increase in the capacity of any given factory by 5 per cent. in order to accommodate the increased number of employees, and, in the second place, it involves an increased wages bill of 5 per cent. if existing weekly wage rates are maintained. Both these charges must fall upon the employer, and tend to increase the price of the commodities he produces. That is one side of the picture. Let us glance at it from another. In Europe and even more in America the object at which every employer aims is the reduction of the incidence of labour costs by the introduction and development of new machinery. If restraint is put upon this activity unemployment will be caused because those who are engaged upon the making of the new machines will be thrown out of work. Hence although a temporary improvement would take place whilst additional machinery and equipment was being provided to accommodate five per cent. more operatives, the final result would not bring about an increase of employment. We need not point to other effects, which must inevitably result from any endeavour to curtail the constant development of the most rapid and cheapest methods of production. We are in this dilemma. If the best means of manufacture are employed the number of hands engaged per unit of production must decrease; if we maintain employment in the commodity-producing factory by rejecting potential developments, the price of the products increases, the demand falls, and those engaged in constructing productive machinery are thrown out of work. We are, indeed, faced by the awkward predicament that whatever we do we shall not be able to employ the surplus million economically in industry if the estimates of national production are correct. If that were the whole problem the *non possumus* attitude of the employers would be fully justified. But there is yet another very important consideration. The doctrine of work or maintenance is now becoming admitted by all nations. Repugnant as it is, even America has been forced to consider the "dole," and in this country it has already taken a permanent place. Now out-of-work relief to one million people cannot, even under the latest regulations, amount to much less than twenty-five million pounds a year, and that sum has to be found, sooner or later, by industry. No one has any doubt that it would be better to spend that money in wages, and since it is equivalent to something between 2 and 2½ per cent. of the industrial wages bill of the country, it offers at least a potential means of meeting a substantial part of the postulated 5 per cent. increase in wages by a similar increase in the number of workers. If the principle is adopted, that in the national interest industry must take steps to absorb its own surplus of labour, then a reduction of this particular burden would seem to be imperative.

We have advanced these few considerations rather with a view to stimulating thought than with the intention of suggesting a remedy for a complaint which is now generally regarded as chronic. We see no likelihood that sporadic action will effect the desired end. A general reduction of wages might achieve the object by making it less necessary for employers to use labour-saving machinery; but, since the purchasing power of labour would be reduced, it might, equally, have the reverse effect. On the other hand, if we assume that a shorter week for the same weekly wages is forced upon employers, then they will be obliged to adopt more and more labour-saving machinery and methods in order to lessen the proportion that labour costs bear to total costs. Hence we should move in a vicious circle, and after a few perilous years return to the condition from which we started. These considerations prompt the conclusion that there are only two issues out of the maze of difficulties: one, increased consumption of commodities; the other, the reduction of the population. But before we resign ourselves to the acceptance of the latter familiar conclusion we trust that a statesmanlike effort will be made to review the whole matter in the national interest, and to discover, if possible, a solution that may be more quickly effective.

### Over One Hundred Per Cent. Efficiency.

FOR several years past Messrs. Brown, Boveri and Co. have been working on the development of steam boilers and gas turbines. Their experiments have led them to the design of an apparatus embodying both a boiler and a gas turbine, each acting as a complement to the other. The boiler abstracts sufficient heat from the products of combustion to enable them to be safely employed to drive the turbine, while the latter is coupled to a compressor which delivers compressed air to the furnace. Combustion, as will be gathered, takes place under pressure, and the high gas velocities which can thereby be secured permit a rate of heat transmission many times greater than that obtainable with ordinary boilers. It will also be noted that whatever power the compressor absorbs is all returned to the furnace in the form of heat or of compression energy. Such, in brief, is the scheme. The plant which has been devised to carry it out is described at some length in a recent number of the *Brown Boveri Review*, and in view of its theoretical and practical interest, we publish an abstract of this description elsewhere in this issue. We need not therefore attempt now to recapitulate its features. It does, however, appear advisable to draw attention to one of the claims made. The claim applies to the "explosion method" of working, in which a charge of compressed air and fuel, exploded in the furnace at constant volume, exhausts finally through the gas turbine, after having been cooled by the boiler surface. The inlet and the outlet to the combustion chamber are controlled by valves and the cycle is repeated from forty to sixty times per minute.

The claim is such an extraordinary one that it will be well to quote it verbatim, together with the antecedent sentences. "If," we read, "by the use of rich combustion mixtures, high explosion pressures are obtained, and the feed water is at the same time at such a temperature as to cool considerably the heating gases, so that the turbine receives cold gas, which is, however, at a sufficient pressure to act as a driving medium, it is not impossible that the flue gases leave the plant at a temperature lower than that of the surrounding air. In this case there is more heat available for generating steam than was introduced in the fuel, which implies that the heating efficiency is greater than 100 per cent. It is evident that we have here merely an ideal case of a 'heat pump' and that there is no contradiction of the second law of thermodynamics." The first statement can be readily accepted. In fact, it might be made stronger, for it is not only "not impossible," but it is absolutely certain that if the gases are cooled to atmospheric temperature before they expand in the turbine, they will be below atmospheric temperature after their expansion. If the expansion is adiabatic, as it must approximately be, the gases will lose about 1 deg. Fah. for every 184 foot-pounds of work they do per pound, and this is true from whatever temperature level they start. Hence if they are anywhere near atmospheric temperature at the inlet to the turbine, they can generate very little power in the latter before their temperature becomes much less than that of the surrounding air. Admitting, then, that it is perfectly easy so to arrange matters that the flue gases are discharged at less than atmospheric temperature, we are faced with the extraordinary inference that "in this case there is more heat available for generating steam than was introduced in the fuel." It is legitimate to ask where this extra heat can have come from. Heat is certainly put into the furnace by the compressed air, which carries with it not only the heat necessarily caused by compression, but also that due to the inefficiency of the compressor itself. All this heat, however, is derived from the power put into the compressor

shaft, and this power can have no other source than the original heat contained in the fuel. Some other answer must therefore be found. Messrs. Brown, Boveri and Co. give it—for their words seem to admit of no other interpretation—by claiming that by reducing the temperature of the flue gases to less than that of the surrounding air, they are, in some way, procuring the extra heat from the atmosphere itself. "We have," they say, "an ideal case of a heat pump, and there is no contradiction with the second law of thermodynamics." Now the ideal heat pump has been a feature of engineering text-books since Kelvin described it, eighty years ago, but it is difficult to see its relevancy to the present case. The only mechanism which can be said to deliver heat is the air compressor, and this has no more right to be called an ideal heat pump than any other compressor.

There is, however, no need to discuss heat pumps, ideal or otherwise. Messrs. Brown, Boveri distinctly associate their claim for an efficiency of over 100 per cent. with the reduction of the flue gases to a temperature below that of the atmosphere. Now, at first glance, there seems something plausible in this. Although common sense tells us that no isolated boiler plant could possibly convey more heat to its contents than that available in the fuel; still, if the flue gases are discharged colder than the air which enters the plant, it would look as if some extra heat must have been extracted from them. And so it would have been, provided the cycle would work. The fallacy consists in the assumption that it will do so. It will be best to quote Messrs. Brown, Boveri's own words in the matter. They say in connection with the explosion method of operation, "The gases give up the whole of their sensible heat to the tubes in order to generate steam, and are thus cooled off before they reach the gas turbine. If, now, the gases are still further expanded in the gas turbine, they are cooled down further in giving up work. The compressor is driven by this work." Now, since the gases have given up all their sensible heat to the boiler before they do work in the turbine, they must enter the latter at or about atmospheric temperature, and consequently leave it at some temperature much colder than the atmosphere. Under such conditions we have no hesitation in saying that the compressor could not be driven by their work, so that the whole scheme of "heat pumping" is founded on a false assumption. We do not read that Messrs. Brown, Boveri ever tried to make the turbine drive the compressor, but if they did we are absolutely certain that they did not succeed in any case in which the discharge temperature of the flue gases was sub-atmospheric. To indicate the theoretical impossibility of the feat, we will consider an air compressor and a gas turbine, both ideally perfect and both operating adiabatically. To simplify the argument, we will assume that both the air and the flue gases behave as perfect gases and that the weight of each is the same. For the turbine to be able to drive the compressor, both machines must work through an equal temperature range, without any reference, however, to the actual temperatures and pressures in each case. This, in itself, does not preclude the turbine from exhausting below atmospheric temperature and still driving the compressor; but we have the further important consideration that the turbine cannot exhaust below atmospheric pressure. Again, the air entering the compressor will be at atmospheric pressure and temperature, while its volume after compression will be equal to the volume of the flue gases entering the turbine by reason of the constant size of the combustion chamber. From these data it is easy to show that the temperature of discharge from the turbine must be equal to the temperature at the inlet to the compressor—that is, at atmospheric temperature. It follows also that if the turbine is to discharge the gases below atmospheric temperature, they must be so reduced in temperature or pressure or both before entering it, that they cannot possibly develop the power required. This condition will inevitably be brought about if the boiler in Messrs. Brown, Boveri's project extracts any more heat from the gases than is contributed by the fuel. Hence we are faced with the alternative, either of having a plant which cannot possibly work or of having one in which the flue gases are not discharged below atmospheric temperature and in which the boiler absorbs no more heat than the fuel has produced. Whichever choice be accepted, it precludes the claim for an efficiency of more than 100 per cent. which has been put forward by Messrs. Brown, Boveri. The conclusion of the whole matter is that there is no hope whatever of increasing the "heating efficiency" of a boiler plant, nor the efficiency of any kind of thermodynamic apparatus by discharging the working substance at a temperature lower than the coolest provided by Nature in the air or water available. All suggestions to the contrary are based on a fallacy.

### Ottawa.

It is as yet rather too soon to say with certainty what effects the Ottawa agreements will have on the iron and steel industries of Great Britain, but at least the leader of the British representatives, Mr. A. J. Grant, President of the National Federation of Iron and Steel Manufacturers, as reported in our Sheffield letter, takes a very hopeful view, which we fully expect to be confirmed by the other representatives of the iron and steel industry. But, if we may so put it, it is the spirit of the Ottawa Conference, rather than its immediate results, that really matters. Frankly, it must be admitted that the terms of the agreements, as far as they affect the engineering industries and as far as they are yet indicated, do not amount to very much; but we must recognise that the difficulties are of a kind that cannot be overcome in a day and are made exceptionally severe by the industrial conditions of all the countries of the Empire. But if the actual terms do not give cause for confidence in an immediate and considerable improvement in the iron and steel trade, it is quite otherwise with the spirit of the conferences. For the first time there was a recognition of the value of the unity of Imperial commerce. At future Conferences the good beginning made at Ottawa will, without doubt, extend, and we may look with confidence to the time when, by agreement, every unit of the Empire will be encouraged to develop those industries for which it is best equipped, and when to each will be secured a safe and sure market for its products. Mr. Baldwin, in an address of thanks to Mr. Bennett for presiding over the Conference, described in a few words what had been attained. "What we have done at this Conference," he said, "is to build a foundation on which we and future generations may erect as fair and staple an edifice as lies in our capacity to accomplish. We have done that, and we have learned more than ever before of each other's difficulties and viewpoints. It only remains for us to try to work out in practice what has been achieved on paper, and with that sanity and forbearance which, I hope, will always characterise members of the British Commonwealth of Nations. Then it may be that the generations coming after, speaking of us, may say indeed, 'They builded better than they knew.'" At present the basis of the agreements, in practically all instances, lies in tariff concessions, but we are bold enough to visualise a time when economic fitness will achieve more than artificial devices, and when tariff barriers will no longer hamper freedom of commerce within the Empire.

## Cavitation.

By G. S. BAKER.

No. II.*

A second possible contributory cause of blade erosion and high slip has been suggested by Mumford. With a screw working at high thrusts there will be an area of reduced pressure extending some distance *in front* of the screw, the reduction growing more intense towards the screw disc. Sea water contains a large quantity of air and gases, and when subjected to this reduced pressure these are given up, and this occurs just in front of the blades. Observations of undisturbed sea water showed that air bubbles were released when the pressure was reduced by 6 lb. per square inch. Taking this as a limiting pressure and assuming that the intake velocity is one-third the velocity imparted to the race, and that the slip measured by the race velocity is 25 per cent., this will give a velocity of the blade of 100ft. per second. A higher velocity could be obtained by assuming a lower fraction for intake velocity. This source of trouble, so far as it may be real, requires the same remedies as the cavitation due to *local* low pressure on the blades. Legras has recently stated that in his work with two circular back sections at very low pressure and high velocity he failed to detect any release of gases from the water, and although these are isolated results, the probability is that this trouble is not present.

A third cause can arise from the flow being influenced by something in front of the screw. If a bossing is placed with the after end *across* the general flow it will direct a fairly wide stream of water at an angle to the fore-and-aft direction. As the blades pass through this stream the slip suddenly changes and recovers. Negative slip and face erosion is sometimes induced in this way. This particular form of erosion always takes some time to develop and may be found at all radii of the screw.

Similarly, the passage through the screw of a fine line of eddies or slowed-up water due to local unfairness may mean a fluttering cavitation. The outward sign of this is a fine line of erosion across all the blades at the same radius. The ends of bossings should be drawn out to a fine taper. Twist of these ends should not be used at all at high speeds, nor without a test to ensure that it is satisfactory at low speeds. Without bossings the flange of the casting securing the bracket arms to the ship, and the ends of these arms themselves should be tapered away, the fore end of the bracket barrel must be curved *slowly* down to the shaft diameter, and the joint of bracket arms and barrel must be so formed as to avoid any pocket at the after end, using a slightly unsymmetrical finish to attain this. The after end of the brackets should have at least 2ft. or 3ft. clear of the leading edge of the screw, more if possible, up to 8ft. with blunt ends. Eggert has shown the large loss in speed which can occur if one of these arms is allowed to come sufficiently near the surface to draw down air. The air streams off the rear of the bracket arm into the propeller, the loss of speed being one to two knots on a destroyer at top speed. Cavitation due to either of these causes is almost invariably accompanied by marked vibration of the propeller.

The following notes may help to put these general theories and ideas into practice, but as the available data are very few they are necessarily not very precise. The solution of any difficulty as regards the direction of flow obviously calls for a model experiment. Emphasis has already been laid on large tip clearance with heavily loaded propellers. The main consideration, therefore, is the design of the propellers.

(1) Since the lift coefficient is limited in value, high thrust must be obtained by raising the area of blade or its velocity. Both of these are achieved by using blades which hold their breadth well out to the tips. Outline B in Fig. 4 is for a three-bladed screw and shows a good type of developed blade outline. For smaller area it can be graded towards outline A. If greater area is required it must be obtained by movement to $C_1$ and $C_2$ progressively according to the demand. Experience with four-bladed screws has shown them to be less satisfactory at high loads than three-bladed.

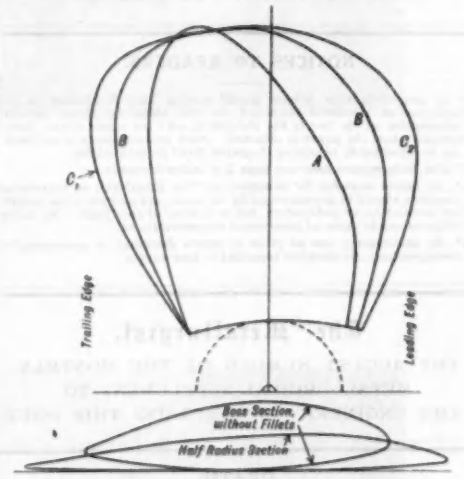

B
B
A
$C_1$
$C_2$
Trailing Edge
Leading Edge
Boss Section without Fillets
Half Radius Section
A is for Four Blades of Moderate Thrust Loading. B for Three Blades near Cavitation Loading, Larger Area with B Leading $C_1$ Trailing Edge. Still Larger Area, with $C_2$ Leading $C_1$ Trailing.
"The Engineer"

**Fig. 4**—*Developed Outlines for High-Speed Screws and Typical Blade Sections.*

(2) Near the blade tips there is a fall in pressure values owing to the free edge effect, and a higher nominal $k_L$ coefficient can be used. Thus at one-twelfth radius in, the actual pressure coefficient is only approximately 60 per cent. that on the same section at the same angle, on an infinitely long blade.

(3) The maximum negative pressure on a blade is largely influenced by the shape of the section quite near the leading edge, but the total pressure coefficient depends on the shape of the whole section. All sections must be chosen with this in mind. Also leading edges must be shaped to metal templates to ensure that all blades are formed alike.

(4) The lift coefficient can be increased by increasing the angle of attack, or by increasing the blade thickness at the same angle. Whichever method is used, the distribution of pressure is broadly the same—compare sections N and O, Table I., page 188, which show the effect of thickness on the same type of section. Experimental data are wanted greatly on the effect of such changes on the ratio $p_m/k_L$, but a broad view of it can be obtained from the figures given with the first article. The obviously desirable forms are those for which this ratio is low and remains constant at this low value for a small range of angle.

(5) Any bluntness of curvature at the leading edge on the backs leads to a relatively high $p_m/k_L$ value—

* No. I. appeared August 19th.

compare sections K and L in Table I. The term bluntness here must be regarded as relative. The radius of curvature of any part of the *back* should decrease *gradually* towards the leading edge, but only at the actual edge should a small radius be used.

(6) Some of the increase in the ratio $p_m/k_L$ can be avoided by washing back the driving face at the leading edge, and rounding it away, as shown in passing from section O to P. Here the camber ratio has been largely increased, but the actual camber of the back has changed only a very little. The easier curvature at the leading edge has enabled this extra thickness to be carried without *any* increase in the ratio $p_m/k_L$. This type of section is adapted for root sections of blades when the camber ratio is above 0·14.

(7) The root section should be chosen with a view to three things :—(*a*) Minimum curvature of the back ; (*b*) keeping the slope of the back of the blade to the direction of motion less than 15 deg. at the trailing edge ; and (*c*) maintaining a water gap between consecutive blades which shall have a minimum amount of variation where they overlap.

(*a*) Can be achieved by rounding the ends and washing back the driving face ; (*b*) is necessary to avoid eddy-making at this part of the blade, and can be obtained by washing back the face at the trailing edge ; the latter is also wanted for (*c*) in any screw in which the root sections are long and the camber ratio exceeds about 0·14.

(8) The sections near the tip should be of the minimum drag type. With thin sections no useful purpose is served by washing back the face at the trailing edge.

(9) Circular back sections cavitate at a lower pressure than suitable aerofoil ones.

*Cavitation Thrust Limits.*—A rough assessment of the area of blade necessary to avoid cavitation loss is obtained from the average thrust per square inch of surface. Obviously, the actual pressure intensity varies across the blade. Also the pressure on which cavitation depends is normal to the blade surface, and not fore and aft as is the thrust. But the relation between these normal pressures and the fore and aft component does not change much with pitch ratio (within practical limits), and the effect of any such relationship is included in the determined mean thrusts. Lerbs recent work suggests that limiting thrust values increase as pitch ratio increases, up to about unity, at which the variation is small, and above which they fall. The following figures are for propellers of either wide-tipped or approaching wide-tipped type of good sections with smooth surfaces :—

With high revolution turbine-driven screws, having a tip clearance of 2·0ft., on a 600ft. ship, tips of the blades immersed 3ft. to 4ft., or well covered by a cruiser stern with easy lines to the hull, a mean thrust of 13·2 lb. per square inch can be allowed. With 10ft. immersion this figure may rise to 14·5 lb. In both cases it is assumed that the shaft is carried on A brackets at the after end. Any attempt to work in this pressure region behind large bossings, leads to more or less serious erosion. With a blade tip clearance of 14in., thrusts of 13·2 lb. per square inch have been measured on Cross-channel steamers with specially designed blade sections. These screws hold their thrust in moderately bad weather, and have shown no erosion after two years' service.

With small tip clearance, there is local vibration at all speeds, and if cavitation develops it occurs on both hull and propeller. The plating is subjected to intense and rapid blows, which produce a loud crisp or cracking noise, and the rivets in the locality are loosened.

With the centre screw of a triple set, experience shows that the thrust should be limited to not more than 10·0 lb. per square inch developed surface, with circular back sections. The wake variation is too serious for any higher figure, and even with the figure given, there should be a fore and aft gap between the leading edge and the body post of at least 4ft. or 5ft.

With a well-balanced quadruple reciprocating engine and twin screws of high revolution, Barnaby found that the pressure limit was given by :—

$$\text{Thrust per square inch } \textit{projected} \text{ area in pounds} = 10 \cdot 85 + \tfrac{3}{4} h,$$

where $h$ is the immersion of the blade *tip* in feet. This figure is considerably lower than the preceding, but is based upon trials of the "Daring," in which the blade tips were immersed only 1ft. and the tip clearance was about 10in. *only*. With such engines of the lower revolutions common in mercantile practice, there is some 5·0 per cent. variation of rate of revolution of the shafts, and even with good clearance the above limit should not be exceeded, and is a little too high for screws behind solid bossings.

With internal combustion engines the momentary variation of rate of revolution is high, and for a four-cylinder engine is about plus and minus 7·5 per cent. Recorded thrusts show a variation up to plus and minus 25·0 per cent. for such vessels, and the blade area should be fixed to meet the higher limit of this variation. For twin screws thrusts of 7·5 lb. per square inch can be used, and with eight cylinders per shaft, the figure can be raised to 8·5 lb. With a centre screw, unless the clearance between the leading edge of the screw and the after end of the body post is *at least* twice the full siding of post and plating, erosion of the blade will appear whatever thrust limit is used.

These limits give the minimum area in each case, but not the *desirable* area. In ordinary intermediate liners, &c., with solid bossings, pressures should not exceed 6·0 lb. per square inch developed surface under working conditions, *i.e.*, when developing a power about 20·0 per cent. above that on the measured mile at the same speed. It should be borne in mind that with twin screws, fairly close to the hull, 6·0 lb. average thrust, will entail a maximum pressure of about 13·0 lb. at certain parts of a revolution.

## Literature.

*Modern Practice in Mining.* Volume 5, *Colliery Machinery and its Application.* By Sir R. A. S. REDMAYNE, K.C.B. London : Longmans, Green and Co. 1932. Price 30s. net.

THIS book forms the concluding volume of a series which deals with the occurrence and working of coal. From the title of the work it will be gathered that it includes a large number of somewhat miscellaneous chapters dealing with the machinery employed for all purposes in the getting of coal and its preparation for the market. As might be expected from the experience of the author, the descriptive portion of the work is very well done, and descriptions will be found in the book of most of the machinery employed in collieries, the descriptions being supplemented in many cases by illustrations of the various machines, which for the most part are exceedingly useful, and, particularly those supplied by the makers of the machinery, are quite correct. It must, however, be pointed out that the author has not described the most modern practice in every case, that he confines himself in the majority of instances to machines used in this country, and has overlooked one or two machines that are in daily use. Unfortunately, the proof reading has been less careful than could be desired, and whilst some of the errors are obvious, others may mislead the unwary. As examples we may mention the statement (on page 22) that "One kilo. of water is equal to 2204 lbs., or 1 ton," and another (on page 243) that "In the case of the scroll drum the rope is wound on spiral grooves on a continually increasing diameter of drum until it finishes at a diameter half as large as that at which it started," and such misprints as (page 269) "feroda" or (page 371) "vena contractor," or the errors in connection with the diagrammatic representation of the forces acting on the headgear and its description on page 213. We suggest that the publishers would be well advised to issue at once an errata slip for inclusion in the volume, as errors which are no more than annoying to the experienced reader may mislead the student.

## SHORT NOTICES.

*Proceedings of the Third International Conference on Bituminous Coal, November 16th to 21st, 1931.* Pennsylvania : Carnegie Institute of Technology, Pittsburgh, U.S.A.—The two volumes containing the papers read at this Conference form a valuable addition to the rapidly increasing number of books on fuel. Coal is dealt with in all its aspects by experts who are to be congratulated upon the interesting and comprehensive papers read. The volumes are sectionalised as follows :—Opening Session ; Economics ; Competition Between Fuels ; Low-temperature Carbonisation ; High-temperature Carbonisation ; Coal Carbonisation Problems ; Gasification ; By-products ; Hydrogenation and Liquefaction ; Railway Fuel ; Steamship Fuel ; Domestic Utilisation of Fuel ; Power Plant Fuel ; Pulverised Fuel ; Smoke and Dust Abatement ; Preparation ; Coal Cleaning ; Origin and Classification ; Steam Purification.

## SIXTY YEARS AGO.

ALTHOUGH to-day the danger of coal dust explosions in mines is fully recognised and generally guarded against by stone-dusting or other means, it is doubtful whether the fact that coal dust can be exploded was realised much before the beginning of this century. Explosions in mines were certainly attributed invariably to fire damp until enlightenment came. Other forms of carbonaceous matter, such as flour dust and the dust produced in oil-cake mills, are almost as readily exploded as coal dust, but it is wrong to suppose, as is sometimes done, that this fact has been established as a corollary to the establishment of the explosibility of coal dust. Explosions in flour mills were not unknown last century, and as there could be no question of fire damp in their case, some other explanation had to be sought. On July 9th, 1872, a disastrous explosion and fire occurred at the Tradeston Flour Mills, Glasgow. The circumstances of the mishap, so we gather from our issue of August 30th of that year, made a considerable impression on the uninformed public mind, and it was commonly asserted as an explanation of the cause that the proprietors of the mills used explosives in the production of their flour. The fire insurance offices took a serious view of the disaster, and at once appointed Professor Macquorn Rankine and Dr. Stevenson Macadam to conduct a searching investigation into it, with a view to discovering its probable cause. As might be expected, Rankine and his coadjutor quickly laid their fingers on the root of the trouble, and produced a report which subsequent experience and investigation have shown not only to be correct, but to be remarkably full and of lasting value. They examined witnesses and documents relating to similar past mishaps, and instituted experiments on the subject. They proved that flour dust was definitely explosive, and estimated the probable maximum pressure which it could develop. They pointed out that the danger lay not in the grinding process proper, but in the arrangements made for withdrawing and storing up the dangerous flour dust. They were satisfied that at the Tradeston Mills the original explosion which led to a fire and a second explosion had started in the exhaust box into which the dust was drawn off from the stones, and that the source of ignition was a spark from the stones which had become heated, and had struck fire as a result of the accidental stoppage of the feed to them. It was recommended that all receptacles in which flour dust was collected or might collect should be lightly constructed and should be placed outside the mill buildings in order that any explosion which might occur should free itself at once, and not be induced to travel back into the mill. Attention was also called to the danger of sparks being drawn from the stones by the presence of nails and other iron objects in the grain, and it was recommended that universal use should be made of magnets for withdrawing all such inclusions.

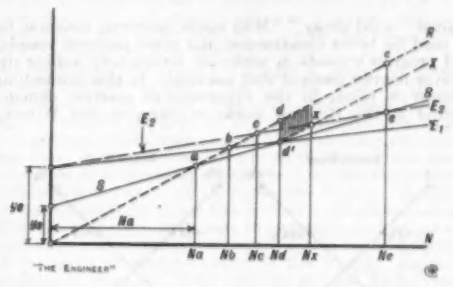
## Letters to the Editor.

*(We do not hold ourselves responsible for the opinions of our correspondents.)*

### ECONOMICS OF URBAN ELECTRIC RAILWAYS

SIR,—In the last few numbers of your journal there appeared the very interesting articles of Mr. H. Watson. Although I am in entire agreement with his ideas, I feel, however, that his deductions would be even more illustrative if the daily or annual number of passengers N were taken along the axis of abscissæ instead of the frequency of traffic.

In this case—see Fig.—the gross revenue would be represented by the straight line R and the total expenditure




by the straight line S for steam traction and E, for electric traction, both having the same speed and frequency. By the very nature of these types of tractions

$$y_e > y_s.$$

but

$$\tan \alpha_e < \tan \alpha_s.$$

This tan increases together with the speed and for "improved" electric traction the line $E_2$ is therefore obtained.

When these four lines are plotted, their intersections give the solutions of all the problems under consideration. As a matter of fact, $N_a$ is the number of passengers at which steam traction begins to be profitable, $N_e$ where this is true for slow electric service, $N_c$ for "improved" electric service, $N_d$ the number of passengers at which both slow electric and steam traction give the same net revenue $d\,d^1$, and $N_e$ the number of passengers at which "improved" electric and steam give the same net revenue $e\,e^1$.

If, then, from $d$ a straight line X is drawn parallel to R, it is possible to determine the point $x$ corresponding to the number of passengers $N_x$ at which the net revenue $d\,d^1$ is also valid for the case of improved electric traction.

G. LOMONOSSOFF.

London, S.W.1, August 16th.

### "SIXTY YEARS AGO," AND NOW.

SIR,—A year or two less than above, the old-time "Flying Dutchman" derailed itself at Long Ashton, on the Bristol and Exeter Railway. The engine was one of Pearson's 9ft., flangeless, double-bogie tanks, behind which I often rode, on my way to King's College.

Some thirty years later a South-Western boat express ran off a curve at Salisbury. And now, a year or so back, a North-Western Scots express did the B. and E. trick, somewhere between Tring and Bletchley, I think. Before the Salisbury disaster, you, Sir, made public an I.C.E. paper with sectional diagrams (I forget the author's name), on what I will call "flange-guiding safety." That learned disquisition was, we may be sure, quite up to the Institution's standard of up-to-dateness. But, Sir, in these days of "Cheltenham Fliers" and such, are we quite sure we are up to date herein in 1932 ?

C. W. V.

N. Lonsdale, B.C., July 27th.

### OIL PAINTING BY FERNELEY.

SIR,—Referring to the picture by Ferneley, reproduced in your issue of August 12th, a friend has suggested that it represents the opening of the Leicester and Swannington Railway, which took place with great rejoicings on July 17th, 1832. As Ferneley was living at Melton Mowbray at the time, which is only 14 miles from Leicester, this suggestion is a highly probable one. I shall be much obliged if anyone familiar with the locality can say whether the picture could possibly represent Bagworth.

C. F. DENDY MARSHALL.

August 23rd.

## Electrically-Welded Boiler Steam Drums.

During recent years improved technique has resulted in stainless steels being successfully welded, tungsten, for example, having been found to be a valuable specific

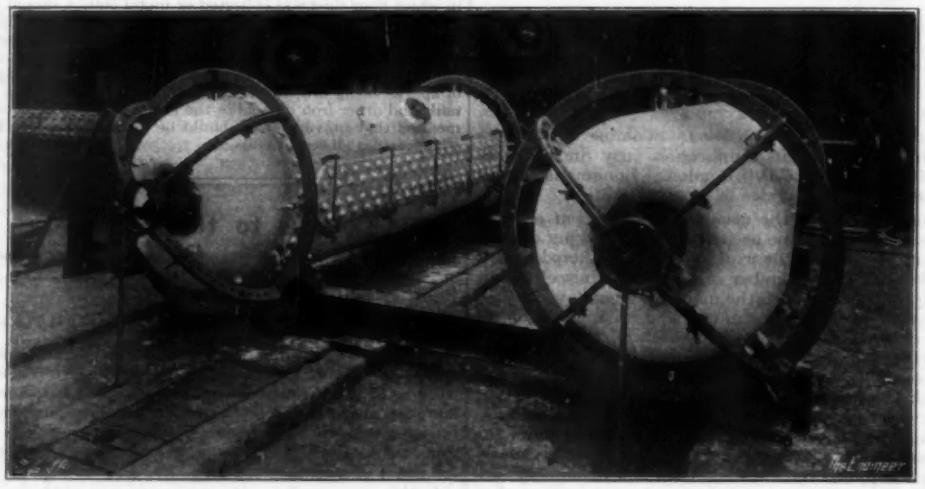


FIG. 1—RIVETED AND WELDED DRUMS READY FOR HYDRAULIC TESTING

against "weld decay." Mild steels, however, continue to be used for boiler construction and other pressure vessels, and progress consists in achieving satisfactory joining up of ever heavier parts of that material. In this connection interest is taken in the experimental practice demonstrated at the Renfrew works of Babcock and Wilcox,

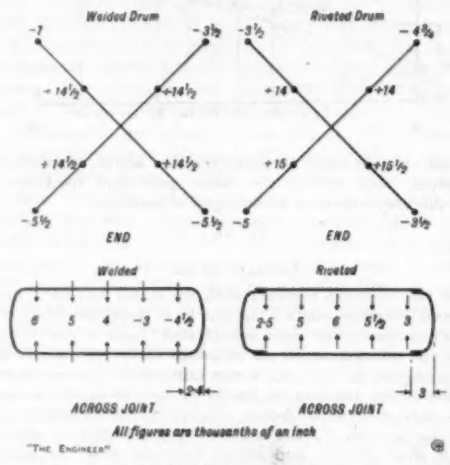



FIG. 2—STRAIN-POINTS

Ltd., on Tuesday, August 16th, which we were privileged to witness. First, a ⅜in. thick sheet of boiler steel, bent to form a cylinder, was mounted on a new electric fusion welding machine developed by American Babcock and Wilcox, Inc. An ⅛in. thick strip of mild steel was tack-welded to form a floor, running the entire length of the shell. The edges of the plate were 1 ¼in. apart at the outside and ⅛in. apart at the inside surface. Long coated electrodes, ⅛in. in diameter, were mechanically fed to the arc from the travelling arm of the welding machine, which is operated by a 440-volt supply transformed down to give 310 ampères at 45 volts across the arc. A weld of this type is, of course, built up in layers, and we noticed that a first layer was laid down at the rate of two-thirds of a foot per minute. A complete weld, we understand, can be made at the rate of one foot per hour for plates up to one inch thick. Caulking and cleaning of each skin follow, together with chipping, if necessary. It should be made clear that the welding machine has at once a vertical and horizontal mechanical feed, rods up to 8ft. long or over, if necessary, being employed.

Fig. 1 shows a pair of steam drums ready for testing. The drum on the left is 1 ⅛in. thick, of riveted construction, according to Board of Trade requirements, to withstand a working pressure of 500 lb. per square inch. The other, electrically welded, is ⅜in. thick, to withstand the same pressure. The test was made with a hydraulic pressure of 750 lb. per square inch, applied six times per minute. Watch type extensometers were fitted at important points on both cylinders and actual readings in thousandths of an inch were as indicated in Fig. 2. The tests will be carried on until failure is shown by the flaking of the whitewash on the welded drum and leakage at the riveted joints of the other drum.

Fig. 3 shows a portable X-ray equipment, by Messrs. Philips. Much attention has been directed to obtaining a satisfactory method of examining welded drum seams, and this equipment has proved particularly suitable. Briefly, the instrument employs both high and low-tension circuits and is water cooled. Unexposed films are carried in a flat box, aluminium fronted and lead backed. The apparatus and its use was fully described in our issue of April 8th, 1932. Films exhibited to us of welds showed no noticeable marking in their region, whilst ordinary tensile test specimens exhibited good factures. Thus far heavy electric welds of the type described have been restricted to work largely of an experimental nature. Once beyond this stage, Babcock and Wilcox propose to carry out the practice on all their boiler work.

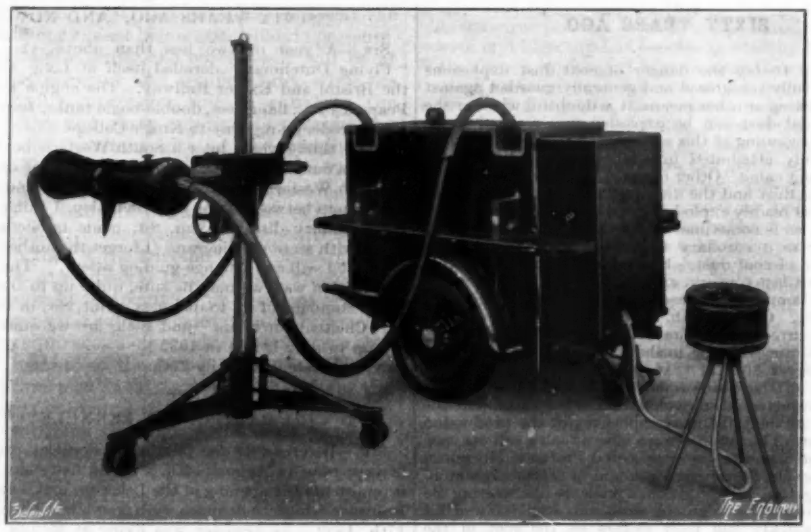


FIG. 3—PORTABLE X-RAY APPARATUS

## A High Gas-Velocity Boiler.*

Although researches on heat transmission belong to the most thoroughly studied domains of physics and technology, test results have been completely lacking up to now at such high gas velocities and temperatures as occur in the gas turbine. These velocities are considerably higher than 200 m./sec. They are therefore in a velocity region in which the influence of the elasticity of the gases can no longer be neglected. We have carried out very complete researches on flow and heat transmission at very high velocities and temperatures and have thus obtained knowledge which confirmed our opinion that important advantages would be obtained in the design of steam generators if, instead of the velocities usual up to the present, which scarcely exceed 15 m./sec., velocities of 200 m./sec. and more were used. In order to be able to use such velocities, however, it was also necessary to find the means which would enable them to be economically produced.

This means is offered by the gas turbine. Two different methods are possible: Constant pressure with a continuous flame, for crude oil and pulverised coal; and explosion, for explosive combustibles such as gases, various oils and pulverised brown coal.

With the constant pressure method, the combustion chamber is charged with a compressed mixture of fuel and air, the pressure of which is kept constant by means of a compressor. The gas turbine driving the compressor obtains its energy from the flue gases which flow from the combustion chamber through the heating tubes. Since, in order to produce the high gas velocities, a certan drop in pressure is necessary, only a part of the pressure drop supplied by the compressor remains available for use in the gas turbine. In order to supply the gas turbine nevertheless with the necessary power for the compressor, the driving gases must still be hot. It follows, therefore, that the gas turbine must be placed somewhere in the middle of the gas flow and that the heating surfaces for producing steam and heating the feed water must be placed after the turbine as well as before it. When necessary, the blades of the gas turbine are provided with cooling. The gas turbine uses up a part of the heat of the flue gases, which is thus taken from the heat available for producing steam; an equivalent amount of heat, however, is delivered back to the combustion chamber by the work of compression in the form of compression energy and heat losses. With the exception, therefore, of the small amount for bearing and leakage or radiation losses, no heat is lost, despite the relatively large amount of energy expended. The careful construction of the heating tubes, which are fitted with nozzles at the entrance and with diffusers at the outlet, and the recompression occurring at high velocities of flow and with intensive heat absorption, result in the actual pressure drops being smaller than would have been expected for the high velocities of flow attained.

In the explosion method, the combustion chamber is periodically charged with an explosive mixture of fuel and gas, which is supplied by a compressor. When charging is completed and all valves are closed, the mixture is ignited; it explodes and due to the explosion its pressure is raised to about 4–5·5 times the charging pressure.† At the expiration of a short period allowed for the complete combustion, a discharge valve placed at the end of the heating tubes communicating with the combustion chamber, opens. The chamber now begins to empty; the hot gases expand and flow very rapidly through the heating tubes. Water is circulated on the outside of the heating tubes, absorbing all the heat contained in the gases and thus being evaporated. The cooled gases, after having passed through the tubes, are not discharged directly into the atmosphere, but are maintained at a certain pressure before the nozzles of a gas turbine, so that they retain a certain part of their pressure drop. When the combustion chamber is emptied to about the charging pressure, the discharge valve of the pipe leading to the gas turbine is closed and a second discharge valve leading to a pipe by-passing the turbine opens as well as the admission valve through which scavenging air and a fresh charge enters. The scavenging air and the fresh charge expel the burnt gases still remaining in the chamber through the heating tubes and the second discharge valve into the atmosphere, upon which a new cycle begins. The discharge valve and the gas turbine are placed, therefore, at the cold end of the heating tubes.

The admission and the discharge valves, as well as the ignition devices, are operated by oil under pressure. The frequency of the cycle is between 40 and 60 per minute, according to the size of the combustion chamber.

Several exceedingly interesting features may be mentioned in connection with the explosion method. Due to the explosion of the compressed charge, a pressure drop is obtained, without additional external mechanical work, which suffices to impart to the gases, not only a high velocity in the heating tubes, but also energy which is used in the gas turbine. The gases give up the whole of their sensible heat to the tubes in order to generate steam, and are thus cooled off before they reach the gas turbine. If, now, the gases are still further expanded in the gas turbine, they are cooled down further in giving up work. The compressor is driven by this work, so that the whole of the work comes back to the combustion chamber with the compressed air and the fuel in the form of compression energy and heat losses. If, by the use of rich combustion mixtures, high explosion pressures are obtained, and the feed water is at the same time at such a temperature as to cool considerably the heating gases, so that the turbine receives cold gas which is, however, at a sufficient pressure to act as a driving medium, it is not impossible that the flue gases leave the plant at a temperature lower than that of the surrounding air. In this case there is more heat available for generating steam than was introduced in the fuel, which implies that the heating efficiency is greater than 100 per cent. It is evident that we have here merely an ideal case of a "heat pump," and that there is no contradiction of the second law of thermo-dynamics.

A further gain of heat is obtained, however, with this process. In the case of combustible mixtures with a high hydro-carbon content, a part of the water of combustion is condensed as a result of the large transfer of heat, as soon as the temperature of the walls of the tubes in, for example, the feed water heater part is lower than the saturation temperature of the water vapour of combustion at the partial pressure prevailing, and this even when the temperature of the heating gases is still considerably higher than the saturation temperature. In this latter case the vapour particles coming in contact with the cold walls of the tubes are certainly condensed, but, as a result of the high velocity of flow, the droplets so formed have no time to be evaporated again in the stream of warm gas.

Practical experience will show to what extent the

* From the *Brown Boveri Review*, Jan., 1932.

† A charging pressure of from 2 to 2·5 atm. abs. is proposed.

recuperation of the heat of the water of combustion and the heat pump effect, which have been observed during the tests, can be realised industrially. From both methods, explosion and constant pressure, high efficiencies are to be expected—from the explosion method on account of the recuperation of the heat of the exhaust gases used in the gas turbine; from the constant pressure method on account of the high temperatures of combustion which can be obtained; from both methods on account of the exceedingly small overall dimensions and good regulation.

## Electrical Equipment at the Kettering Iron and Coal Company's Works.

DURING the past few years important electrical work has been carried out at the Northamptonshire Works of the Kettering Iron and Coal Company, Ltd. A new 250-kW gear-driven pass-out D.C. turbo-generator set, a

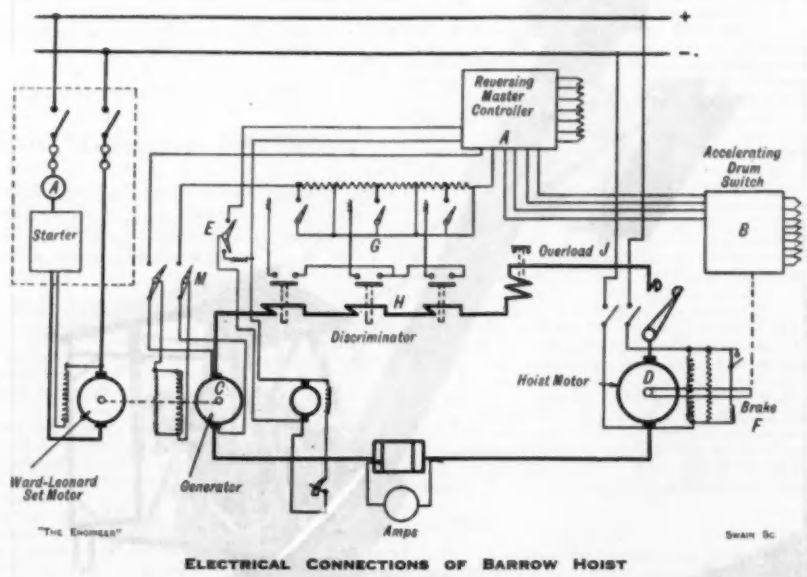
ELECTRICALLY-DRIVEN BARROW HOIST

300-kW reciprocating D.C. generating set, main switchboard, and a number of motors have been installed, together with equipment for an electrically operated barrow hoist. The firm responsible for the work was the General Electric Company, of Magnet House, Kingsway, W.C.2. All the electrical plant was made at Witton, Birmingham, whilst the pass-out turbine was constructed at the company's Fraser and Chalmers Engineering Works, Erith, Kent. The electrically-driven barrow hoist, shown in the first illustration, is capable of rapid and smooth acceleration, even retardation, and automatic and accurate decking. After the operator has started the cage the acceleration, retardation, and stopping are entirely automatic. The hoist is operated by a 60 horse-power D.C. motor, which is controlled by a 40-kW Ward-Leonard set connected to a 460-volt, three-wire D.C. system, supplied by the 250-kW geared turbo-generator set, whilst the 300-kW machine serves as a standby set.

The Ward-Leonard motor generator is automatically controlled by a master controller and an accelerating drum switch, which is driven from the winder shaft. The master controller A, shown in the diagram, is operated through rods by a handle situated at the foot of the hoist. For normal working conditions this controller has two main operating positions, namely, "raise" and "lower," and on moving the controller over to the former position the exciter contactors E for the Ward-Leonard generator close, and the generator C is excited by a weak field current, thus starting the hoist motor D. Immediately the hoist begins to move the accelerating drum switch B is operated by the winder shaft, and progressively raises the field current of the generator to its full value, thus automatically accelerating the hoist motor to its full speed. As the hoist reaches the limit of its travel, the accelerating drum switch automatically retards the hoist motor by reducing the field current of the generator C, until, finally, a limit switch trips and opens the field circuits of the hoist motor and Ward-Leonard generator, and applies the solenoid brake F to the hoist. For lowering the hoist the same sequence of operations is obtained by moving the master controller over to the "lower" position.

The hoist is used for ironstone, limestone, or coke. Each of the two barrows will take 15½ cwt. of ironstone, and as a barrow weighs 7½ cwt., the total load raised by the hoist when dealing with limestone is 46 cwt., whilst if coke is being handled the total load is 27 cwt. Thus as the load varies over a relatively wide range, it has been necessary to pay special attention to the question of decking, and a set of three contactors G, together with a load-discriminating relay H, have been provided. Each contactor is energised by the operation of its relay and short-circuits a small resistance in the field circuit of the Ward-Leonard generator, thereby raising the generator voltage and increasing the output of the hoist motor. In this way the generator voltage and motor output are automatically increased when the hoist handles heavy loads, so that the hoist always travels at its maximum speed and decks accurately. When the barrows are empty the equipment conforms to this condition. A creeping speed is provided for rope inspection.

Protection of the equipment is provided by an overload relay J in the hoist motor circuit, and an emergency switch mounted below the operating handle of the master controller A. Operation of either of these devices trips the main and exciter contactors and automatically applies the solenoid brake. Although, when the hoist motor stops, the field of the Ward-Leonard generator is broken,




ELECTRICAL CONNECTIONS OF BARROW HOIST

in the absence of proper precautions, creeping of the hoist might occur, owing to a small voltage being produced by the residual magnetism of the set. A small double-pole, double-throw contactor M is therefore provided, and when the field has been de-energised the field circuit is connected across the generator armature in such a manner as to prevent any building up of the generator voltage. In the event of the current failing during any part of the travel the hoist is automatically stopped, and as under this condition the accelerating drum switch would not be in the correct position for starting, another resistance is provided in the generator field system. When restarting this resistance can be cut out gradually by slowly operating the master controller, so that the motor can be accelerated to the speed corresponding to the position of the accelerating drum switch, after which this switch automatically takes over the control of the hoist. Under normal service conditions this resistance is completely short-circuited by moving the master controller to either of the main running positions. A system of electrical interlocking is provided between the upper and lower stages of the hoist. Instruments in the motor-room indicate the exciter voltage, the current taken by the hoist motor, and the line current.

The scheme of electrification mentioned at the outset has led to considerable economies, and certain obsolescent boiler plant has been eliminated. The 250-kW pass-out turbine was specially designed to meet the somewhat unusual conditions of steam supply at these works, where there are two banks of boilers, giving steam at 60 lb. and 150 lb. per square inch respectively. All the boilers are fired with rough-cleaned blast-furnace gas, and the steam at 60 lb. pressure is used for driving certain reciprocating blowing engines. The turbine, which takes steam at 150 lb. pressure, is capable of carrying its full load with all steam passing out at 60 lb. pressure, thereby supplementing the steam from the boilers working at 60 lb. pressure. As the blast-furnace gas supply to the boilers is subject to fluctuations, arrangements have been made to cope with the most extreme conditions met with, and by making the fullest use of exhaust steam for feed water heating, and treatment, by providing better regulation of the gas supply and better arrangements for burning it, all coal firing has been eliminated, notwithstanding that an increased electrical load is now carried.

The turbine has two velocity stages, each with two rows of moving blades, the first stage being designed to expand the steam from 150 lb. to 60 lb. per square inch, and the second from the latter pressure to atmospheric pressure. All the steam from the first stage passes out into the 60 lb. per square inch main, the steam to the second stage being admitted through a reducing valve. If the steam raised in the high-pressure boilers is insufficient to carry the works load on the first stage of the turbine, then the reducing valve opens and admits steam from the 60 lb. supply to the second stage, whilst when the pressure in the low-pressure main tends to rise, owing to a surplus supply of steam from the 60 lb. boilers, the reducing valve opens to allow steam to pass through the second turbine stage, the high-pressure steam consumption being, of course, correspondingly reduced. The turbine reducing valve is controlled by an "Area" regulator, which tends to maintain a constant pressure of 60 lb. per square inch in the low-pressure steam main, and at the same time the reducing valve is also under the control of the turbine speed governor, as occasionally the pressure in both steam mains falls below normal. In this case the "Area" regulator closes the reducing valve, but if there is insufficient steam from the high-pressure boilers to maintain the load on the generator, the reducing valve opens by reason of the action of the speed governor, in spite of the "Area" regulator tending to close it. Both the 150 lb. and 60 lb. steam admission valves of the turbine are connected to the emergency governor. The flexibility of this turbine has made it possible to utilise the fluctuating supply of steam from the two sets of boilers working at different pressures, and to meet the whole power demand of the works.

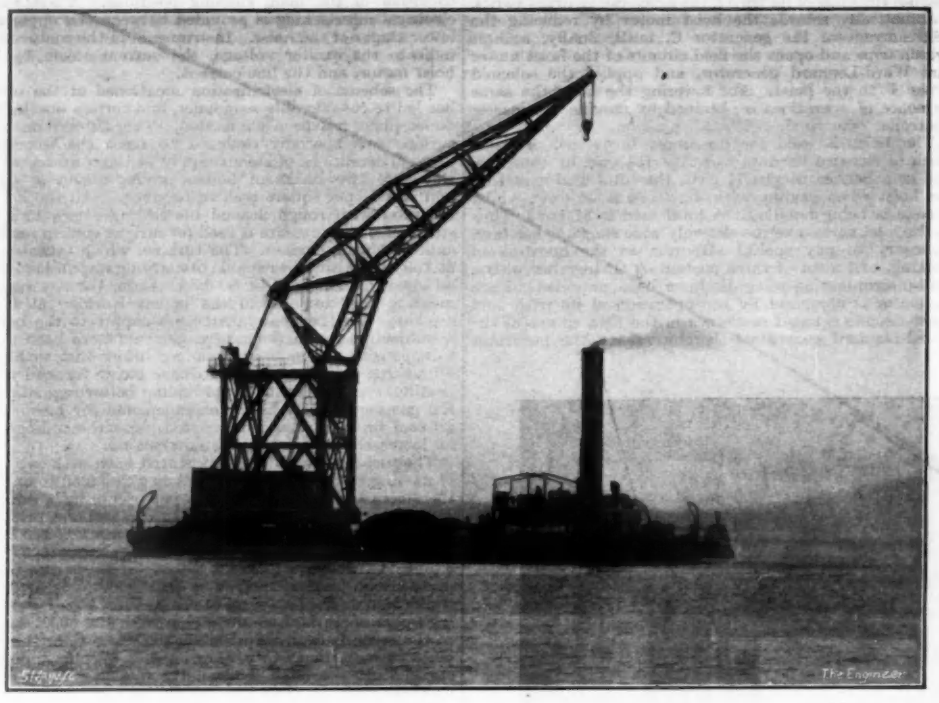
## A Screwing Machine.

THE accompanying illustration shows a screwing machine made by Charles Winn and Co., Ltd., of Birmingham. It is the smallest size in a range of such

SCREWING MACHINE

machines, is capable of screwing tubes or bolts from ¼in. up to 1in. diameter, and is equipped with a self-contained electric drive and a two-speed gear-box. If belt drive is required three step cone pulleys are fitted. The motor is mounted on an extension of the base and connected to the gear-box by a noiseless chain drive enclosed within the pedestal. The headstock, it will be noticed, is cast solid with the bed. The die spindle is hollow and the dies are of the adjustable chaser type. There are four chasers for each die and they are set in position by a concentric cam

PONTOON CRANE FOR DURBAN HARBOUR



action controlled by a nut on the outside of the die head. A feature of the machine is the bow lever non-stop release, which enables the dies to be opened and closed without stopping and without interfering with the adjustment for the diameter being screwed.

## Pontoon Crane for Durban Harbour.

WE show in the engraving above a self-propelling pontoon crane which has recently been completed to the order of the High Commissioner of the Union of South Africa for service in Durban Harbour. The principal contractors are Cowans, Sheldon and Co., Ltd., of Carlisle, who designed and supplied the crane, the pontoon and propelling machinery being supplied under a sub-contract by Harland and Wolff, Ltd., who constructed the pontoon at their Govan works. The pontoon has a length of 150ft., with a beam of 50ft. and a depth of 11ft. 6in. It is built on the longitudinal system, and complies with Lloyd's special regulations for harbour service. An elm belting, 24in. deep, is fitted around the sides and ends of the hull at deck level, and all the equipment usual for a crane pontoon is provided. The propelling machinery comprises a twin-screw arrangement of triple-expansion steam engines, with a total designed output of 200 I.H.P., giving a service speed of 5 knots, and steam is raised in a single cylindrical boiler. The crane, which is operated by steam power, has a lifting capacity of 25 tons, with a maximum working radius of 80ft. Hoisting, revolving, and luffing motions are provided, the latter being of the screw-operated type. The jib is carried on a comparatively high structure, and is specially designed to give the maximum clearance over the side of the ship. All the motions are controlled by one man from the cabin, which is situated immediately below the jib foot pins.

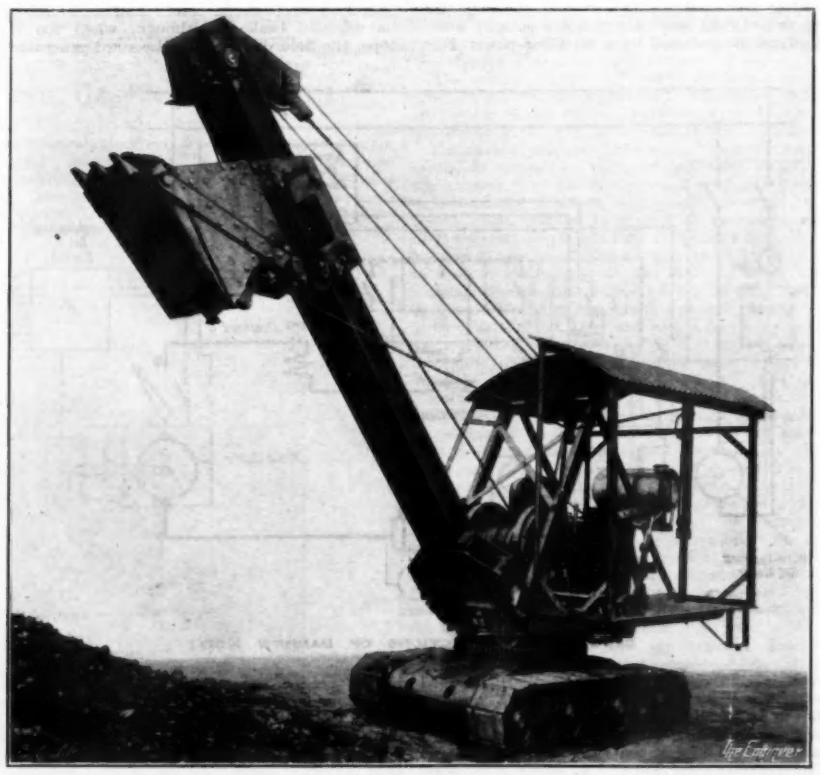
The entire crane revolves on a live ring, which is carried on a steel roller path of large diameter attached to the deck and supported by girders of heavy construction. The ballast which is required to give the necessary stability is carried in a tank situated at the back of the crane. It will be seen that the crane is erected at the forward end of the pontoon, thereby leaving a large space on the deck amidships, in which a maximum load of 120 tons can be carried. The illustration given shows the crane in the working condition, but arrangements are made whereby the jib can be lowered and stowed during the time the pontoon is being towed out to Durban.

## A New Small Excavator.

AN increasing demand has been felt by public authorities, contractors, and ballast merchants in this country for a small, mobile excavator, of light weight and low ground pressure, moderately priced and costing little to run. To meet these requirements a new "Universal" excavator, known as the "Cub," having a capacity of ¼ cubic yard, has recently been produced by Priestman Brothers, Ltd., of Hull. This excavator, which is illustrated by the accompanying tone engraving, whilst resembling the firm's larger machines, embodies certain new features found to be essential on a machine of the small size under review.

The "Cub," by the use of only two jibs, is convertible into a shovel, dragline, trencher, skimmer, grab, crane, or light pile driver, and the weight in working order, complete with one attachment, is about 6 tons. The ground pressure is only 7–8 lb. per square inch, so that the excavator is able to travel and work with safety on ground where the use of a larger and heavier machine would be impossible. The undercarriage, with race, is of all-steel construction and the creeper track belts are constructed on similar lines to those incorporated in the larger size. They are each supported by four cast steel rollers of large diameter running on full-length axles. The power transmission to the final drive is through steel machine-cut gearing protected from the ground by cast steel guards. No chain drives are employed in any part of the excavator. The main bed-plate, which carries both the winch and the engine mounting, is made as a single steel casting with the object of ensuring correct alignment of the gearing throughout the life of the machine. All the gears are of cast steel, machine cut, and the main drive from the engine to the countershaft is enclosed in an oil bath. Power is provided by a four-cylinder engine suitable for running on paraffin after being started up on petrol and developing 20 and 25 horse-power respectively on these fuels, the consumption being about ¾ gallon per hour.

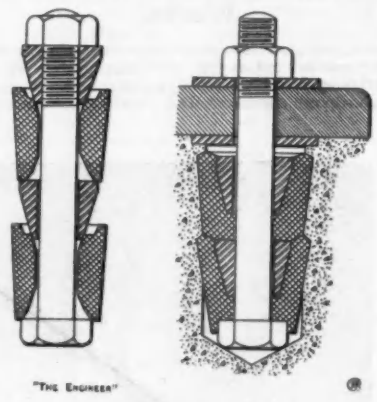
The driver, for whom a seat is provided, has a clear and uninterrupted view of the work from his position at the front of the control platform, and the clutch levers and brake foot pedals are conveniently grouped in a quadrant within easy reach. Relay clutches of the firm's special design are fitted to the hoisting and drag drums, and their design is such that a very small effort on the part of the driver is sufficient to engage them. The patent "Level-cut" grab fitted to the excavator is a new introduction, designed for cleaning narrow ditches. It is held on the rope while it digs and takes a long level cut, leaving clean sides and a flat bottom. The majority of the other attachments are of similar design to those fitted to the larger excavators.



¼ CUBIC YARD EXCAVATOR

## A Holding-down Bolt.

A SIMPLE form of holding-down bolt, or anchor, which may be dropped into a blind hole and then pulled up tight, is illustrated by the accompanying sketches. It is the invention of Mr. N. Phillips and is made by Armstrong, Stevens and Son, Ltd., and A. D. Hayes, Ltd., of Birmingham. The general principle is to thread the bolt,



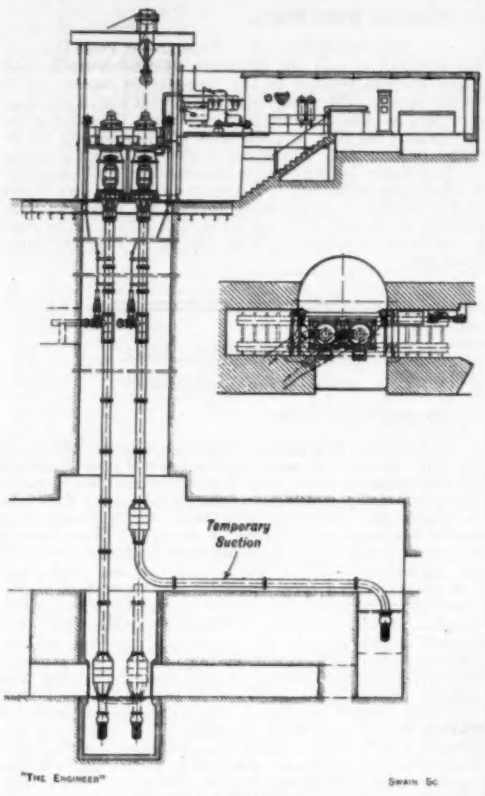

HOLDING-DOWN BOLT

head first, into a hole in the foundation, wall, or whatever it may be, with one or more lead sleeves that nearly fit the hole. These sleeves are shown with double cross-hatching in the sketches. Above each sleeve there is threaded a steel cone, single-hatched. When the whole has been assembled the top cone is given a few taps with a hammer to expand the sleeve and give the bolt a preliminary grip in the hole. Thereafter the more the bolt is pulled up by its nut the tighter will be the grip, and it would seem that the limit of strength will be set either by the parting of the bolt stem, the shearing of the head through the lead, or the bursting of the foundation.

## A Deep Well Pump for Mine Drainage.

IN general it is natural to think of deep-well and bore-hole pumps in connection rather with the supply of water than for any other purpose, and it is apt to be forgotten that such pumps are also very suitable for mine drainage and similar requirements. The line engraving on the next page shows the layout of a pumping plant for the drainage of a mine in South Wales, supplied by Sulzer Bros., of Winterthur, Switzerland. The pumps are electrically driven and are capable of lifting 150,000 gallons of water per hour from a depth below ground level of 568ft. The pump is built in four stages and the water is delivered through a side gallery into a watercourse draining to a

nearby river. The rising main of each pump is made up of sixty-seven sections of solid-drawn steel tubing, each part of which is 8ft. 2½in. long by 16in. internal diameter. A "T" piece fitted in each main 83ft. below ground level provides the outlet. Each outlet is fitted with a valve controlled by rods from hand wheels at the motor floor level. The shaft, made up in as many sections as the rising main, is guided by lignum vitæ bearings and enclosed in a protective tube through which filtered water is passed. The 6600-volt, three-phase, 50-cycle motors run at 1480 r.p.m. and give 700 B.H.P. Each has its own thrust and guide bearings and is connected by a flexible coupling with the pump driving shaft. Each pump is suspended from the surface by means of the rising main which is joined




MINE DRAINAGE PUMPS

to a head box. The pump rotor and the driving shaft are hung from a Michell thrust bearing in the motor pedestal. All the controls for each pump are situated at the surface, and safety devices are incorporated which shut down the pump if the water level in the pit falls too low; if the pump for any reason ceases pumping; or if the lubricating water supply to the shaft bearings or cooling water supply to the pump thrust bearings becomes insufficient or fails. It is claimed for this type of pump for mine drainage that it can be largely automatic in operation, thus rendering continuous attention unnecessary and reducing labour costs very considerably. It has also the advantages that the motor cannot be "drowned," while flooding of the pit to any level will not interfere with the working of the pump.

## British Standards Institution.

*All British Standard Specifications can be obtained from the Publications Department of the Institution at 28, Victoria-street, London, S.W. 1. The price of each specification is 2s. 2d. post free, unless otherwise stated.*

### TRACK-CIRCUIT INSULATION.

No. 456—1932. A further specification in the series of British Standard Specifications for Railway Signalling Apparatus has now been published, this new specification being No. 456—1932, Track-circuit Insulation. The dimensions of every component of the sets of insulations for bullhead and flat-bottom rails are specified, together with the permissible tolerances. The specification contains twelve illustrated plates in addition to several general clauses. The specifications for rail joint insulations which have been worked to in the past by the various railways and contractors have differed slightly in several respects, and the unification of all these specifications should therefore be of considerable assistance without in any way interfering with current practice in all cases where British Standard rails are used.

### TUNGSTEN FILAMENT ELECTRIC LAMPS.

No. 161—1932. The Committee responsible for the preparation of this specification met first early in 1931 with a view to considering further directions in which it could be improved and made more valuable to those interested in lamps and lighting. The most important respect in which it differs from previous editions is in connection with the table referring to dimensions of lamps for general service.

The valuable work done prior to the issue of the 1930 specification, which enabled exact dimensions, viz., overall length, diameter of the bulb, neck dimensions and filament centre, for lamps up to and including the 100-watt size, has now been completed by specifying exact similar dimensions for the larger lamps from 150 to 1500 watts.

The dimensions for these lamps are now clearly specified for British Standard lamps for general lighting services, and we are further informed that the dimensions adopted have been accepted by lamp manufacturers all over the world. This marks a real achievement in standardisation, as it does away once and for all with the difficulties so frequently experienced in the past as to fittings which would only accommodate the lamps of one manufacturer. Naturally, a world-wide agreement meant some concession on the part of the B.S.I., but substantially the existing British Standards have been adopted for all sizes except the 200-watt and 1000-watt, for which lamps the dimensions and light centre have been slightly reduced.

Beyond this important step forward the other alterations are comparatively trivial, the chief being that the clauses referring to testing have been made clearer so as to indicate the proper procedure for selecting a few lamps from a large batch so as to ensure that the selection really represents the whole batch and not merely one section of it. It has been found in practice that the clauses in their old form were liable to be misunderstood and had resulted in those responsible for testing lamps selecting a few lamps from one box only, and considering that these would necessarily be representative of the lamps contained in ten or twenty boxes, which, of course, is not the case.

Price, in cloth with thumb holes, 5s. 4d. post free.

## Provincial Letters.

### THE MIDLANDS AND STAFFORDSHIRE.

*(From our own Correspondent.)*

**Further Encouragement.**

With the merging of summer into autumn there are indications in Midland and Staffordshire industrial circles of an increased interest in trade, and prospects of amended activity in some departments of iron and steel production and engineering manufacture are becoming slowly brighter. This week there has been added to the improvement mentioned in my last letter a little additional interest in the raw iron department, foundrymen having circulated inquiries which encourage hope of improved business. True, the inquiries so far appear to be quite tentative, but actual business is definitely expected to materialise. A number of the finishing trades in this area are emerging from their summer inertia, and while only the specially fortunate producers and fabricators in Midland and Staffordshire trades have any considerable amount of work on hand, others are preparing for anticipated business and spirits are slowly rising. There is more animation in trade circles than for some time past, though it is apparently due more to expectations than to tangible business increase.

**Iron Outlook Improves.**

Blast-furnacemen in the Midlands are receiving a little more support from the light foundries, and inquiries current this week are of a more encouraging nature. In one or two instances they relate to forward supplies. Smelters would be glad, indeed, to see a return to the policy of long-date contracts, the present method of hand-to-mouth buying being most unsatisfactory. It is not certain that foundrymen have improved their position with regard to work booked, but stocktaking and repairs have been got through and more attention is being given to raw material requirements than has been the case of late. Stocks in consumers' hands have been kept low, and foundries are now planning for some increase of demand in the autumn. Reports are current that certain of the engineering foundries participate in the improving tone. It would appear that certain of the inquiries now in being are on behalf of these concerns which have had a lengthy spell of curbed activity. Very little business has, as yet, developed, and it would be unwise to deduce that engineering foundrymen have better prospects. It is clear, however, that they hope for a revival of trade at a very near date, and smelters join them in wishing materialisation of their hopes. Furnacemen would be happy to receive an increased call for raw iron. At the moment more pig iron is being produced than the market can absorb. At some of the Northamptonshire furnaces the accumulation of stocks has been causing anxiety for months past. Derbyshire furnacemen have found openings for their output because of sustained activity at the pipe foundries. There is very little prospect of real improvement at the forges, which for some time past have been taking very limited quantities of forge iron. In existing conditions, consumers can obtain supplies at short notice and are not generally inclined to commit themselves far ahead. Selling prices of Midland brands of pig iron are on the basis of £3 6s. for No. 3 Derbyshire foundry iron, and £3 2s. 6d. for the corresponding grade of Northamptonshire, figures which have stood since May of last year. Forge iron, which is quoted 5s. less than No. 3 in each case continues a disappointing market.

**Steel.**

The position in regard to heavy steel shows but little improvement. Steel manufacturers are struggling to obtain sufficient specifications to keep the mills rolling from day to day. General engineering firms have not been buying steel in any quantity, and structural contractors have also been obliged to limit their specifications owing to the scarcity of contracts for new buildings or projects involving reconstruction. Fortunately, in this branch, a few more inquiries are now in circulation, and it is hoped business will develop in the near future. The bridge-building and other constructional yards are unable at date to place orders of any weight, but small tonnages of material are required week by week. There is no incentive to place forward contracts, however. Motor car manufacturers are inclined to take a hopeful view of the outlook, but at the moment their requirements are not on a big scale. The market remains sluggish, but selling prices of finished material are firmly held. Angles are £8 7s. 6d., less 15s. rebate to users of British steel only; tees, £9 7s. 6d., less 15s.; joists, £8 15s., less 22s. 6d.; ship, bridge and tank plates, ¾in. and over, £8 17s. 6d., less 15s. Boiler plates sell at between £8 7s. 6d. and £8 10s. Re-rollers are experiencing a diminished consumptive demand and keen competition, foreign products being offered at low prices. The lowest figure at which district makers will sell bars is £6 7s. 6d., even in the case of bars manufactured from imported billets; but French and Belgian exporters offer bars at from £4 18s. 6d. to £5 2s. 6d. Continental strip is also obtainable at considerably below district rates. The home price of mild billets are controlled at £4 17s. 6d. to £5 7s. 6d., according to the tonnage ordered, and hard billets at £6 12s. 6d. minimum. Sheet bars vary from £4 17s. 6d., or half a crown less in special circumstances, to £5 5s., against about £4 10s. for imported bars. Although the volume of steel coming in from the Continent in the last quarter has been comparatively small, existing stocks are still a serious obstacle to any improvement in the demand for English billets and small steel bars. Staffordshire hoops are maintained at £9 10s. per ton delivered. As autumn approaches prospects for the steel trade become brighter, and September should see some forward movement initiated.

**Galvanised Sheets.**

A solid basis of trade in the galvanised sheet industry is lacking, but overseas business is on a slightly larger scale than of late. Tonnages remain very small when compared with customary weights. Mills in this area are competing strenuously for the business on offer, but prices are not so readily cut. Indeed, the advancing prices of non-ferrous metals are imparting rather more firmness to selling prices of galvanised sheets and tin-plates. Quotations for 24 gauge corrugated sheets remain at £9 2s. 6d. to £9 5s. per ton f.o.b. Liverpool. Much less is heard, however, of the acceptance of such figures as £9 per ton which have been freely reported on 'Change in Birmingham of recent weeks. Few, if any, of the local mills are well placed for business, and it is only with difficulty that they are able to maintain regular rolling. They hope that the slight improvement noted above will expand. Demand from home sources is up to recent levels.

**Finished Iron.**

There is no improvement in the finished iron trade in Staffordshire. The inflow of orders since the holidays has been of small moment. Plants are being worked at a great disadvantage, running intermittently on small orders which involve such frequent changing of the rolls and so much wasted energy in the mills that costs are altogether disproportionate to output. There is little or no prospect of stirring the market out of its present stupor by offering iron at a cheaper rate. Makers of marked bars are in a slightly more favourable position than those producing Crown and common bars, though orders from the railways and other large undertakings can no longer be relied upon. Prices have not altered in any of the different brands of finished iron. The existing basis for best grade bars of £12 at makers' works has not been varied for more than fifteen months. Crown bar prices are irregular. Staffordshire makes, which are regarded as of superior quality, are still quoted between £9 and £9 15s., but makers in districts outside are prepared to accept orders at £8 15s., or even less. Fencing iron costs around £7 15s., and nut and bolt bars £8. Belgian No. 3 bars are obtainable at £5 15s. to £6. Dealings in iron strip are on the basis of £10 7s. 6d. to £10 10s. The Black Country tube trade is not over bright and demand for strip is below normal. Most of the mills could well do with additional business in bulk.

**Fire At Black Heath.**

Damage estimated to amount to £30,000 was caused by a fire this week at the works of T. W. Lench, Ltd., nut and bolt manufacturers, Black Heath. A tank containing 18,000 gallons of oil by some means caught fire, and burning oil flowed from a crack which appeared in the side of the tank, but was prevented from running into workshops and on to the road near the works by an embankment of soil and sand, which was rushed into the works in carts and lorries. Eight fire brigades were unable to extinguish the flames in the tank or to prevent another oil tank containing 9000 gallons of oil and workshops adjoining becoming involved. The tanks were burning for nearly six hours. With the aid of a special apparatus for throwing foam on to the fire the burning oil which fell to the ground was extinguished, but the supply of foam was insufficient to enable the raging furnace in the tanks to be coped with. The firemen succeeded in confining the outbreak to a comparatively small area, though, at one period, it was feared the whole works would become involved. The screwing shop and a large portion of the warehouse, which contained hundreds of tons of nuts and bolts packed in bags, were destroyed. The firm employs 1300 hands, and it is expected that a good number will be temporarily thrown out of work.

### LANCASHIRE.

*(From our own Correspondents.)*

MANCHESTER.

**Under a Cloud.**

Those branches of Lancashire engineering and the iron and steel trades generally whose interests are to a greater or less degree bound up with those of the cotton trade are much perturbed regarding the labour outlook in the premier industry of the county. The support which the cotton mills have accorded to engineers during the past ten years has been substantially less than was the experience in times of more normal activity, but in spite of the vicissitudes of the mills the cotton trade is still the keystone of Lancashire's industrial prosperity. A stoppage of the mills, once in operation, might easily repeat the

history of previous disputes, and drag on interminably, with its ill-effects in evidence long after a resumption had been made. To the extent that efforts are being made to bring both sides into touch again before the stoppage actually begins, the outlook may be said to be brighter, and there is a widespread hope that a spirit of reasonableness will prevail now, as it will inevitably have to do sooner or later, and possibly after almost irreparable damage has been done.

**Engineers and Export Credits.**

As already indicated in this column, a number of engineers in Lancashire and West Yorkshire have been adversely affected by the restriction of export credits in connection with Russian business, and it is reported to be for this reason that at the works of George Richards and Co., Ltd., of Broadheath, near Manchester, it has been decided as from last week-end to put into operation the "short week," no work being done on Saturday mornings. Nearly 400 men are affected. On the general question of export credits for firms which have the opportunity of securing further Russian orders, the matter has been considered by the Manchester and Salford Trades Council, which has passed a resolution urging the Government and the Export Credits Guarantees Department to afford reasonable facilities to concerns that have prospective business of this nature.

**The Lancashire Wagon Company.**

It is announced that the offer of Sir Connop Guthrie, chairman of the North Central Wagon Company, Ltd., Rotherham, to purchase the preference and the ordinary share capital of the Lancashire Wagon Co., Ltd., Bury, has been accepted by the directors, who have recommended its acceptance to shareholders. Rather more than a year ago the shares of the Yorkshire Railway Wagon Company, Ltd., Wakefield, were acquired by the North Central Wagon Company, and the former company was wound up shortly after.

**Non-ferrous Metals.**

The feature of the non-ferrous metals market during the past week has been the continued strength in all sections. The further gain so far as tin is concerned has only been to the extent of a shilling or two compared with a week ago, and for the time being at all events the advance in this metal appears to have come to an end. On the other hand, copper, lead, and spelter, particularly the two first, have all registered important rises again. There has been no big weight of business passing in the tin market during the week, and at times, due to profit-taking operations, a certain amount of reaction was in evidence. The losses were subsequently made good, however, and at the moment of writing quotations are about half a crown a ton above those ruling a week ago. The demand for copper has been on a moderate scale, although in the aggregate the turnover has not been quite so heavy as in the previous week. Values of standard brands of the metal are about £2 10s. a ton higher than at last report, with corresponding advances in the refined descriptions. A better buying movement has been experienced in the lead market on trade account, and the tone in this section is distinctly brighter than it was recently. The rise in this metal has ranged from about 12s. 6d. to 15s. a ton. Inquiry has also been rather better in the case of spelter, and prices are higher on balance by roughly 5s. a ton.

**Iron and Steel.**

There has been little sign as yet of any resumption of buying interest on the Lancashire iron and steel markets, and there is no doubt that the threatened strike in the cotton industry tends to hold up fresh business. Holiday influences, however, are still an important factor in this respect, although the next three or four weeks should witness brisker conditions in most sections. Odd contract orders for foundry iron have been reported during the past few days, but apart from these, both inquiry and actual new business have been of small dimensions. For delivery to consumers in the Manchester district, Staffordshire, Derbyshire, and Cleveland brands are all quoted at 67s. per ton, Northants, at 65s. 6d., Derbyshire forge at 62s., Scottish No. 3 at about 84s. 6d., and West Coast hematite at 81s. The demand for bar iron is quiet still, but offers are maintained at £9 15s. per ton for Lancashire Crown bars and £10 5s. for best bars. In the steel market, the call for most varieties has been confined to odd specifications for early delivery. For the most part, locomotive builders in Lancashire have little work in hand, apart from repair jobs, and there is not much activity among constructional engineering firms. Some forge makers this week have experienced a little more inquiry. In most cases machine tool makers in the district are poorly engaged, and this is reacting upon the demand for alloy steels. Prices of all heavy steels are steady to firm at about £8 10s. per ton for boiler plates, £7 for small re-rolled bars, £8 15s. for joists, £8 7s. 6d. for sections, £8 17s. 6d. for ship and tank plates, and £9 7s. 6d. for large-diameter bars. An attempt is being made by sellers of Continental products on this market to secure better prices, and in several sections current quotations represent an advance of from 2s. 6d. to 5s. per ton compared with a week or two ago. This, however, has had no apparent effect on sales locally, for the demand for foreign products remains poor.

BARROW-IN-FURNESS.

**Hematite.**

There is nothing fresh to report on the hematite pig iron market, which continues to be dull, with scarcely enough demand to clear the production of iron, despite the restriction of output. The furnaces at Barrow have not restarted yet, and it is probable that they will not be producing again until the rail mills have been got to work again. The business abroad is very flat, and such shipments that have left the port are mostly intended for home customers. A little is trans-shipped occasionally at Liverpool from Barrow. The native iron ore trade, in view of the small number of furnaces in blast, is very quiet, and large stocks exist on the surface at some mines. Foreign ore is in very easy demand. The steel trade is very quiet. Workington has a fairly good order for sleepers to work on and a few rail orders may be coming to the district shortly. The only mills engaged at Barrow are the hoop and small section, the rail mills not having been got to work yet. Shipping continues to be dull. Engineering is moderately employed, and shipbuilders are badly in need of fresh orders. It is possible that there will be better news for the district in the course of a week or two.

## SHEFFIELD.

*(From our own Correspondent.)*

**Rather More Cheerful.**

ALTHOUGH there is no actual improvement in local trade to report, a more cheerful tone is to be found in several circles. Buyers in foreign markets are showing a tendency to replenish somewhat the stocks of materials and goods which have been allowed to become exhausted, and this tendency would be stimulated by any modification of existing restrictions upon currency movements. Scrap dealers are taking a more optimistic view of the situation. They find that rather better deliveries are going into consumers' works, and, while they cannot point to any positive development, they are beginning to think that things have touched bottom and are probably rising a little. The market is fairly firm. Prices are still low, but with a hardening tendency.

**Round the Works.**

Open-hearth steel production remains on about the same level as recently reported. As this is the dead season, there is some ground for modified satisfaction in the fact that output is maintained without further shrinkage. It probably represents, however, on the whole, less than half the capacity of the plants. At Templeborough, where the United Steel Companies have been able to increase their production this year, they still have six furnaces in operation out of a total of fourteen, which, allowing for furnaces down for repair, is equal to rather more than half the available capacity. At their Rotherham works, two furnaces out of eight are in commission. Most of the business placed in this trade is for immediate requirements only, and the bulk-buying movement which has been so long awaited has not yet made its appearance. There is not much employment for the heavy manufacturing and engineering departments. The call for shipbuilding steel is still very limited, and there is much shortage of work in the railway axle, tire, and spring shops. The Crown Agents for the Colonies have placed an order for tires with Brown Bayley's Steel Works, Ltd.

**The Lighter Branches.**

Better reports are still forthcoming, as for some time past, from the lighter branches of local trade than from the heavy. The automobile builders are taking good quantities of parts and special steel from Sheffield, although their demands at present are not up to recent averages, as we are between seasons, and orders for the new season's requirements are not yet being placed. The stainless steel department continues healthy, and there is a substantial output of the various classes of its goods. The call for cold-rolled strip is quite good, and there is also a very fair demand for best wire.

**Back from Ottawa.**

The leader of the British iron and steel delegation to the Ottawa Conference was Mr. A. J. Grant, managing director of Thos. Firth and John Brown, Ltd., Sheffield, and president of the National Federation of Iron and Steel Manufacturers. He has returned to the city very optimistic about the benefits to the industry which are likely to result from the Conference. "If the British industry," he said in an interview, "takes full advantage of the expressed Canadian intention to divert as large a proportion of their imports as possible to British sources, a very substantial increase in business to Great Britain should result." Sheffield already exports a fair amount of stainless, tool, and alloy steels to Canada, and he thinks there will be better terms for some of these products. One suggestion considered was that the Canadian steel industry might confine itself more to the primary products, whilst obtaining from us the more specialised things, such as forgings, alloy steels, and tool steels, for which their market is limited, and which we can supply to the world. Mr. Grant explained that the British delegation met the representatives of the steel industry in Canada prior to the Conference proper, and were able to reach a great measure of agreement. As far as he knew when he left Ottawa, practically all the terms of this tentative agreement were confirmed.

**Low-temperature Carbonisation.**

It is understood that the whole of the rights in the Salerni process of low-temperature carbonisation—experimental work in which was recently carried out at the University of Sheffield—has been acquired by Neanthracite, Ltd., of which Sir Eric Hambro is chairman. A Neanthracite experimental retort has been built in Sheffield and installed in the company's premises near the centre of the city, and work carried out on it is stated to have definitely proved the actual process of Salerni coal refining. Neanthracite, Ltd., expects to be in a position to call for tenders for the full-scale plant at the end of this month, and Sheffield manufacturers will have an opportunity of quoting. Sir Eric has agreed to use his best endeavours to enable the full-scale plant to be installed in the Sheffield area, but this, of course, can only be brought about if the facilities offered in the area are equal to those elsewhere.

**Progress of the Safety Blade.**

The increasing export of safety razor blades is one of the most striking features of the cutlery trade—a trade which has few grounds for satisfaction at present. These exports now exceed one-half of the whole cutlery total. While exports of knives, scissors, and ordinary razors show a falling off, the safety blade has saved the overseas situation. The July total of cutlery exports was £11,000 more than that of June, and £14,000 more than that of July last year. For the seven months of this year there is an increase of nearly £73,000 on last year, the respective figures being £419,763 and £346,771. Safety blades account for nearly the whole of this increase. The value of the blades exported this year alone has been £174,913, and, as the bulk of these sell retail at 1d. each, the number must be enormous. The Australian market for cutlery has been gradually gaining ground during the past few months, and its purchases in July were worth twice as much as those of June. There was a falling off in the Canadian and New Zealand figures.

**Peakland Water Scheme.**

The Parish Council of Hope, in the Peak District, has decided to call the attention of Chapel-en-le-Frith Rural District Council to the necessity of increasing its water supply. The village was threatened with a shortage recently, as the demand was exceeding the supply by 300 gallons per day, and the level of the reservoir fell to only a few inches. The water is obtained from a spring in the hills on Jagger Clough above Edale, and conveyed 3 miles along the hillside to the reservoir. It has been found that two other springs, close to the one now used, are running to waste. It is proposed that all the three shall be connected together, and the catchpit on Jaggers Clough enlarged.

## NORTH OF ENGLAND.

*(From our own Correspondent.)*

**Cleveland Iron Trade.**

THERE has been little business on the Cleveland pig iron market this week, but a hopeful note is struck by the restarting of the four blast-furnaces at the Skinningrove Ironworks, which have been closed down a fortnight to enable the necessary alterations for a change-over to the electrical grid scheme to be made. Iron-making was again in full swing at the week-end, when the remaining departments of the works—coke ovens, steel plant and rolling mills—were brought into operation again. The Loftus ironstone mine, from which the works draws supplies of ore, were also reopened on Monday. The slowest month of the year is nearing its close, and an early expansion in business is hoped for. The pulse of the market, unfortunately, is still feeble, and the first signs of improvement have yet to develop. Buyers still display a marked reluctance to pay the quoted prices for Cleveland iron, and whilst no doubt their own needs are limited, it is difficult to resist the conclusion that the price level is holding up trade. There is no indication from the makers that reductions are contemplated, and only Scottish consumers can buy below the fixed rates, which are: No. 1 foundry, 61s.; No. 3 G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d.; No. 4 forge, 57s.

**Hematite Pig Iron.**

Recent sales of East Coast hematite pig iron to South Wales and Italy are encouraging and indicate that the area of distribution is broadening, but competition for orders is still very keen. For some time past sales have been impossible, except at figures well below the cost of production. Merchants have fairly large holdings, which they are keen to unload. The market rate for mixed numbers is no more than 60s., while No. 1 quality is offered at 60s. 6d. Two blast-furnaces at the Ayresome Ironworks, Middlesbrough, are expected to be rekindled at the end of this month or early in September, so what seems the already ample production of pig iron is to be increased.

**Ironmaking Materials.**

Business in foreign ore is almost at a standstill. Consumers have fairly heavy stocks, and have no need to enter the market. The nominal price of best Rubio is 14s. 6d. c.i.f. Tees. Now that the Skinningrove works have restarted there is a bigger consumption of blast-furnace coke, but supplies are abundant at 14s. 6d. delivered to works in this area.

**Manufactured Iron and Steel.**

There is still little life in the manufactured iron and steel trade, but the works have all restarted and hopes are entertained that the Ottawa agreement will lead to increased business with Canada, and also with other Dominions.

**The Coal Trade.**

The proverbially dullest month of the year in the coal trade is drawing to a close, and a revival in the seasonal demand for household coal may be experienced in the very near future. As to foreign business, it can scarcely get any worse, and may improve, though, on that point, it is possible to speak only with reserve. Countries with coal of their own seem resolved to use more and more of it, to the exclusion of outside fuel. Then there is the handicap of minimum prices, which are undercut by foreign sellers. Nevertheless, the prompt trade in progress is far from negligible, and it may be that in the coming winter producers will have to rely principally on this type of business. Durham has its large home sales of gas and locomotive coals, and Northumberland is well maintaining the larger coasting connections it picked up a few years ago at the expense of Midland districts. Thus, on a general look round, an accession of orders may be reasonably expected in the near future. Northumberland steam coals, both prompt and forward, remain easy, buyers having no difficulty in obtaining any class or quantity at the schedule minimum, securing loading berths and obtaining quick loading turns. Large steams are freely quoted at 13s. 6d., Tyne prime 12s. 9d., and other classes 12s. to 12s. 6d. Wear prime steams continue

quiet, but there are some Norwegian inquiries circulating which, if resulting in business, would brighten up the September outlook. Durham gas fuel is in abundant supply, but new business is scarce, the market remaining inactive and easy at 14s. 6d. for best qualities, with secondary descriptions quoted 13s. to 13s. 6d. Coking unscreened and small show no feature of note, prices being unchanged at 12s. 6d. to 13s. 3d. Best grade bunkers are in steady request, although the demand is still confined to prompt loading positions, forward business being in abeyance. Prices are firm for best descriptions at 13s. 6d. to 13s. 9d., but easy for other brands at 13s. The demand for gas coke continues steadily, the production being readily cleared and firmly quoted at 17s. 3d. prompt and 17s. 6d. forward. Stocks on the ground are not excessive, and remain firmly held. Patent oven coke is steady, but there are ample supplies of good brands at 14s. to 14s. 6d., and superior makes at 15s. 6d. to 16s.

### Miners' Stoppage Averted.

A threatened stoppage of work at Whitburn Colliery, near South Shields, at the end of this week, affecting about 1400 hands, has been averted by the men involved withdrawing their notices and agreeing to resume negotiations. The notices were tendered by the underground workers, and have been withdrawn on the advice of the Durham Miners' Association. In consequence of this the notices given by the management are also withdrawn. Negotiations are to be carred on between representatives of the men's lodge and the owners, the Harton Coal Company, to reach a settlement. In the early part of August the colliery was laid idle by the management owing to the putters having refused to discontinue alleged restriction of output. Work was resumed three days later, pending negotiations, but it is stated that the men failed to get what they considered satisfaction from the management and tendered their notices. Following this step the management gave a fortnight's notice to the surface workers. Another interesting development in the Durham coalfield is the acceptance of piece rate cuts by 270 miners, whose notices had expired at Washington F. Colliery, in an effort to keep it going.

## SCOTLAND.

*(From our own Correspondent.)*

### Mechanical Coal Loaders.

ALTHOUGH it is only three to four months since the M. and C. Joy loaders were introduced, these machines have already found considerable favour. Just recently a demonstration under working conditions was witnessed by railway, gasworks, civil, and mining engineers at the East Kilbride works of Mavor and Coulson, Ltd., the makers. This firm has specialised in coal-mining machinery for many years, and in their factory the first completely enclosed electrical coal cutter was constructed. The mechanical loaders now being made at the East Kilbride factory are being constructed for underground and surface use. The underground machine loads at the rate of 1 ton per minute, and the surface machine at 2 tons per minute.

### Trade Outlook.

The trade position has not undergone much change recently; in fact, conditions are similar to those pertaining prior to the holidays. At the same time, there is an undercurrent of confidence that has strengthened to some extent since the conclusion of the Ottawa Conference. Already this year there has been a material increase in trade with Canada, and there are strong possibilities that a larger increase will be experienced as a result of the recent negotiations.

### Steel and Iron.

The lack of specifications for shipbuilding material is still the chief anxiety. Port-Glasgow is the one bright spot in the shipbuilding industry, but until the yards on the upper reaches show more signs of activity, the outlook for the iron and steel trades is not likely to improve much. Plates and sections are poorly specified, though there has perhaps been a shade more inquiry during the past week or two. Steel sheets of the lighter gauges have a moderate turnover, but heavy black and most descriptions of galvanised sheets are rather quiet. Inquiries for tubes are a little better. Bar iron and re-rolled steel bars move very slowly. The former, at £9 15s. per ton, has to face competition from home steel as well as from imported material, while the cost of the latter is still high at £6 10s. home (fixed) and £6 7s. 6d. per ton export, compared with competitive material.

### Pig Iron.

The production of pig iron in Scotland is still confined to the output from one furnace. Stocks, however, are ample, and consignments continue to arrive from England and India. Two weeks ago about 1300 tons arrived from Calcutta, and last week 350 tons came from Millom. Local prices are unchanged.

### Scrap.

The market for scrap continues without much movement, and prices are unchanged round about 45s. per ton for cast iron machinery and 35s. per ton heavy steel.

### Coal.

In all districts the demand for large coal is much below normal, owing to a drop in home consumption and the difficulties in the way of export business. Fifeshire first quality and to a lesser degree Lothians steams are exceptions. Washed nuts are the strength of the market at present. Owing to reduced outputs, supplies of these are fully taxed, and in most cases are fully booked up for two weeks ahead. Treble nuts are especially strong, particularly in Fifeshire. Aggregate shipments amounted to 220,224 tons, against 245,410 tons in the preceding week, and 194,253 tons in the same week last year. The Latvian State Railways are in the market for 25,000 tons of coal, tenders to be presented at the end of this month.

## WALES AND ADJOINING COUNTIES.

*(From our own Correspondent.)*

### The Coal Trade.

HOPES are entertained that now that the Ottawa Conference has come to a close, the Government will as soon as possible turn its attention to our trading relations with Continental countries, as from the coal export point of view there is much that requires serious consideration. The South Wales Coal Exporters' Association received information at the end of last week that on the 12th inst. France and Poland signed an agreement, as the result of which the monthly quota of Polish coal which can be imported to France was raised from 40,000 to 100,000 tons. The Association is now endeavouring to ascertain details of this arrangement, as if it is correct the conclusion drawn is that it certainly cannot be to the advantage of the coal export trade of the United Kingdom. Then, again, the news has come to hand that a tentative agreement between the Belgian and German Governments has been come to, though the actual details are not yet known, but it was mentioned recently that the Belgian Government proposed to reduce the import quota for British coals from 93,250 tons per month by 50 per cent. Action on these lines was, however, postponed until the beginning of September because of the negotiations between Belgium and Germany. Any steps that may be taken abroad to curtail the coal export operations of this country can only be regarded with the utmost seriousness, in view of the restricted state of trade at the present time. Certainly the anthracite section of the industry continues to maintain its activity, and last month the figures were a record in respect of shipments to Canada, but there is no bright spot about the steam coal department of the industry. Still, the returns of all coals shipped last week from South Wales at the ports under the control of the G.W.R. Company marked a welcome recovery upon the figures for the preceding two weeks, as the total was 398,750 tons, against 371,215 tons and 244,765 tons. The conditions, on the whole, however, cannot be described as at all satisfactory, as taking the steam coal ports it has to be admitted that the docks are only working at less than a third of their capacity. At Swansea the position certainly is much better, as there is constant loading pressure in respect of anthracite coals. At the end of last week the situation was that between the ports of Newport and Port Talbot no less than forty-six vacant loading berths were to be found, while on Monday of this week the number was thirty-four, which is not too good a start. Actual new business coming on the market for prompt supplies of steam coals is very restricted, and there is not a great deal of inquiry about in respect of contracts. The order for 7000 tons of steam coals for delivery at Haifa for account of the Palestine Railways has been secured by the Maris Export and Trading Company, Ltd., while the Norwegian State Railways are in the market for 20,000 tons of locomotive coals for delivery over the last quarter of this year, but the bulk of this order is likely to go to competitors in the North, and the same applies to the inquiry from the Latvian State Railways, which have invited tenders for 25,000 tons. Prices have to be received by the 31st inst. The report was current at the end of last week that shipments from this district were to be resumed for account of the Italian State Railways, in connection with the agreement under which the Italians undertook to take a million tons annually for a period of three years from this country, but inquiries fail to secure any confirmation of the report.

### Respite for Penarth.

There is now some news to hand as to the intentions of the Great Western Railway Company in respect of its proposed action for effecting economies in view of the contraction which has taken place of recent years in coal export trade of this area. It will be recalled that it was quite on the cards that the company would close the Penarth docks, because of the fact that the maximum amount of economy would be achieved by shutting down a whole unit, instead of cutting down the coal-loading facilities at all the ports. The traders of Penarth, however, bestirred themselves to avoid such action, and recently a representative deputation interviewed the general manager. The result is that the chairman of the Penarth Council has had a letter from the G.W.R. Company intimating that the company has decided to defer action for a period of twelve months. No secret is made of the fact that the company has been largely influenced in its decision by the action of the Earl of Plymouth in offering to forego for one year all dues from the dock, estimated at nearly £3000, payable to his estate. Hopes, of course, are entertained that in the course of the next year there will be an improvement in trade, and that the closing of the dock will ultimately not become necessary. It may be added that the tradesmen in Penarth promised to do their best to induce dealers to send their goods only over the railways. The necessity for the G.W.R. Company to take steps to effect economies may be gauged from the fact that the company claimed that for some considerable time they had been losing a sum in the region of £14,000 a year on running the Penarth Dock.

### Traffic Returns at South Wales Docks.

There was an improvement in the returns of trade at the South Wales docks under the control of the G.W.R. Company for the four weeks ended July 31st. Imports and exports combined came to 2,148,744 tons, made up of 306,834 tons in respect of imports and 1,841,910 tons exports, which compares with an aggregate of 2,144,487 tons for the preceding month, the latter figure being made up of imports 263,324 tons and exports 1,881,163 tons. For the first seven months of this year the total trade of the docks, amounting to 15,443,391 tons, falls materially short of the aggregate for the same period of 1931, for which the total was 16,375,653 tons. Exports alone for the first seven months of this year came to 13,430,696 tons, as compared with 14,052,058 tons for the same period of 1931, and with 18,651,082 tons for the first seven months of 1913. In the case of imports, the total of 2,012,695 tons compares with 2,323,595 tons for the first seven months of 1931 and with 3,013,703 tons in the same period of 1913.

### Coal Trimmers' Wages.

No agreement was come to at the proceedings last week in London of the National Joint Coal Trimming Committee respecting the proposals of the shipowners for a reduction of 10 per cent. in the national wage rate of the coal trimmers and a revision of certain terms of the tariff agreement. The representatives of the workmen strenuously opposed the proposal, as was expected, but agreed to meet later to give further consideration to the matter. This means that reference will be made to the various districts for further instructions, so that there can be no change in the situation for about a month. In the meantime existing rates and conditions will operate. It is stated that no alternative proposals were put forward by either side in the course of the negotiations.

### Current Business.

Nothing of note has happened during the past week to place any different complexion on the market for steam coals. Anthracite coals are firm, but steam coals of most descriptions are in excessive supply, and consequently remain at the minima. Dry sized coals are an exception to this, as these qualities are scarce. Coke is a slow market, but patent fuel is well stemmed for prompt loading. Pitwood is offered rather more freely, but prices remain about 23s. to 23s. 6d.

## EDUCATIONAL INTELLIGENCE.

CITY OF LONDON COLLEGE.—A course of twenty-five lectures on Iron and Steel will be given by Mr. T. Barton Kelly on Thursdays, from 6 to 7 p.m., commencing September 22nd, 1932.

THE SIR JOHN CASS TECHNICAL INSTITUTE.—The new session of the Sir John Cass Technical Institute, Jewry-street, Aldgate, E.C. 3, which extends over about 36 weeks, will begin on Monday, September 19th, and students will be enrolled during the preceding week.

## LAUNCHES AND TRIAL TRIPS.

BERGANGER, single-screw motorship; built by the Netherland Shipbuilding Company, to the order of Messrs. Westfal-Larsen and Co. A/S, Bergen, Norway; dimensions, 486ft. by 61ft. by 39ft. 6in.; to carry cargo. Engines, oil; constructed by A.E.G., Berlin; trial trip, August 15th.

## PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE SPERRY GYROSCOPE COMPANY, Ltd., announces that Commander the Most Hon. the Marquess of Milford Haven, G.C.V.O., was elected chairman of the board of directors on July 28th last.

CRANE, Ltd. (formerly Crane-Bennett, Ltd.), informs us that its address has been changed from 120, Pall Mall, London, S.W.1, to 45–51, Leman-street, London, E.1. Its new telephone number is Royal 7343 (12 lines).

ASHMORE, BENSON, PEASE AND CO., Ltd., Stockton-on-Tees, have entered into an arrangement with the Atlas Car and Manufacturing Company, of Cleveland, Ohio, for the exploitation of its coke oven specialities.

THE BRITISH ALUMINIUM COMPANY, Ltd., Adelaide House, King William-street, London, E.C.4, is removing its London warehouse from 34–38, Banner-street, Golden-lane, E.C.1, to 23–25, Pancras-road, N.W.1.

F. C. HIBBERD AND CO., Ltd., 16, Northumberland-avenue, London, W.C.2, inform us that they have purchased the assets and goodwill, together with patents, patterns, and drawings of the locomotive business carried on by J. and F. Howard, Ltd., of Bedford.

HARPER AND MOORES FIREBRICK COMPANY, Ltd., Stourbridge, has been formed to acquire and carry on the firebrick business of Harper and Moores, Ltd. The colliery undertaking belonging to the latter company has been disposed of. The services of the late managing director, Mr. V. R. Westcott, have been retained. The financial position of the new company has also been greatly strengthened, as all the debentures have been extinguished.

## CONTRACTS.

HUDSWELL, CLARKE AND CO., Ltd., Leeds, have received from Messrs. Beswick's Lime Works, Hindlow, near Buxton, an order for a standard gauge Diesel locomotive, using a six-cylinder Mirrlees engine of 100–120 H.P. This is the third repeat order received from this firm. The company has also received an order from J. C. Robinson and Sons, Ltd., of Chesterfield, for a standard gauge Diesel locomotive, 70–80 H.P., using a four-cylinder Mirrlees engine.

"SANDS, CLAYS, AND MINERALS is the title of a small quarterly magazine devoted to economic minerals. Whilst it is published by Algernon Lewis Curtis, of Chatteris, who is a supplier of sands, clays, and minerals, it cannot be strictly regarded as a trade publication, for the contents deal with general subjects, as, for example, "Slate," "Lithographic Abrasives," "Precious Stones," "The Analysis of Clay," and so on. The quarterly is well illustrated and well produced.

POPPET VALVE GEARS FOR LOCOMOTIVES.—The rotary cam poppet valve gear supplied by Associated Locomotive Equipment, Ltd., and also its associate, the Société d'Exploitation des Procedés Dabeg, is designated by both firms as the "R.C." poppet valve gear. In like manner, the oscillating cam poppet valve gear also supplied by both firms is known as the "O.C." poppet valve gear. In the past these gears have been described as the Dabeg, A.L.E., or Lentz poppet valve gears, but these designations have now been replaced by those noted above.

# Current Prices for Metals and Fuels.

## IRON ORE.

| | |
|---|---|
| N.W. Coast— | |
| (1) Native | 16/6 to 20/– |
| (1) Spanish | 17/– to 22/6 |
| N.E. Coast— | |
| Native | 18/– to 21/– |
| Foreign (c.i.f.) | 14/6 |

## PIG IRON.

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| (2) Scotland— | | |
| Hematite | 3 8 6 | — |
| No. 1 Foundry | 3 12 0 | — |
| No. 3 Foundry | 3 9 6 | — |
| N.E. Coast— | | |
| Hematite Mixed Nos. | 3 0 0 | 3 0 0 |
| No. 1 | 3 0 6 | 3 0 6 |
| Cleveland— | | |
| No. 1 | 3 1 0 | 3 1 0 |
| Siliceous Iron | 3 1 0 | 3 1 0 |
| No. 3 G.M.B. | 2 18 6 | 2 18 6 |
| No. 4 Foundry | 2 17 6 | 2 17 6 |
| No. 4 Forge | 2 17 0 | 2 17 0 |
| Mottled | 2 16 6 | 2 16 6 |
| White | 2 16 6 | 2 16 6 |
| Midlands— | | |
| (c) Staffs.— | (*Delivered to Station*). | |
| All-mine (Cold Blast) | — | — |
| North Staffs. Forge | 3 1 0 | — |
| „ „ Foundry | 3 6 0 | — |
| (c) Northampton— | | |
| Foundry No. 3 | 3 2 6 | — |
| Forge | 2 17 6 | — |
| (c) Derbyshire— | | |
| No. 3 Foundry | 3 6 0 | — |
| Forge | 3 1 0 | — |
| (3) Lincolnshire— | | |
| No. 3 Foundry | — | — |
| No. 4 Forge | — | — |
| Basic | — | — |
| (4) N.W. Coast— | | |
| N. Lancs. and Cum.— | | |
| Hematite Mixed Nos. | 3 15 6 (*a*) / 4 0 6 (*b*) / 4 5 6 (*c*) | — |

## MANUFACTURED IRON.

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| Scotland— | | |
| Crown Bars | 9 15 0 | 9 5 0 |
| Best | — | — |
| N.E. Coast— | | |
| Iron Rivets | 11 5 0 | — |
| Common Bars | 9 5 0 | — |
| Best Bars | 10 5 0 | — |
| Double Best Bars | 10 15 0 | — |
| Treble Best Bars | 11 5 0 | — |
| Lancs.— | | |
| Crown Bars | 9 15 0 | — |
| Best Bars | 10 5 0 | — |
| Hoops | 12 0 0 | — |
| S. Yorks.— | | |
| Crown Bars | 9 15 0 | — |
| Best Bars | 10 15 0 | — |
| Hoops | 12 0 0 | — |
| Midlands— | | |
| Crown Bars | 9 0 0 to 9 15 0 | — |
| Marked Bars (Staffs.) | 12 0 0 | — |
| Nut and Bolt Bars | 8 0 0 to 8 10 0 | — |
| Gas Tube Strip | 10 10 0 | — |

## STEEL. (*d*)

| | (6) Home. £ s. d. | (7) Export. £ s. d. |
|---|---|---|
| (5) Scotland— | | |
| Boiler Plates (Marine) | 9 0 0 | 8 10 0 |
| „ „ (Land) | — | — |
| Ship Plates, ½in. and up | 8 15 0 | 7 15 0 |
| Sections | 8 7 6 | 7 7 6 |
| Steel Sheets, ¼in. | 7 15 0 | 7 15 0 |
| Sheets (Gal. Cor. 24 B.G.) | 11 0 0 | 9 10 0 |

## STEEL (*continued*).

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| N.E. Coast— | | |
| Ship Plates | 8 15 0 | 7 15 0 |
| Angles | 8 7 6 | 7 7 6 |
| Boiler Plates (Marine) | 10 10 0 | — |
| „ „ (Land) | 10 0 0 | — |
| Joists | 8 15 0 | 7 7 6 |
| Heavy Rails | 8 10 0 | — |
| Fish-plates | 12 0 0 | — |
| Channels | 10 5 0 | £9 to £9 5s. |
| Hard Billets | 7 2 6 | — |
| Soft Billets | 5 10 0 | — |
| N.W. Coast— | | |
| Barrow— | | |
| Heavy Rails | 8 5 0 | — |
| Light Rails | 8 10 0 to 8 15 0 | — |
| Billets | 6 10 0 to 9 0 0 | — |
| Manchester— | | |
| Bars (Round) | 9 7 6 | — |
| „ (Small Round) | 6 15 0 to 7 0 0 | — |
| Hoops (Baling) | 10 0 0 | 9 15 0 |
| „ (Soft Steel) | 9 0 0 | 8 15 0 |
| Plates | 8 17 6 to 9 2 6 | — |
| „ (Lancs. Boiler) | 8 10 0 to 8 12 6 | — |
| Sheffield— | | |
| Siemens Acid Billets | 9 2 6 (basis) | — |
| Hard Basic | 8 2 6 and 8 12 6 | — |
| Intermediate Basic | 6 12 6 and 7 2 6 | — |
| Soft Basic | 5 15 0 | — |
| Hoops | 9 10 0 to 9 15 0 | — |
| Soft Wire Rods | 7 10 0 | — |
| Midlands— | | |
| Small Rolled Bars (all British) | 7 0 0 to 7 5 0 | — |
| Small Re-rolled Bars | 6 7 6 to 6 10 0 | — |
| Billets and Sheet Bars | 4 17 6 to 5 7 6 | — |
| Galv. Sheets, f.o.b. L'pool | 9 2 6 to 9 7 6 | — |
| (2) Staffordshire Hoops | 9 10 0 | — |
| (d) Angles | 8 7 6 | — |
| (d) Joists | 8 15 0 | — |
| (d) Tees | 9 7 6 | — |
| (d) Bridge and Tank Plates | 8 17 6 | — |
| Boiler Plates | 8 7 6 to 8 10 0 | — |

## NON-FERROUS METALS.

| | |
|---|---|
| Swansea— | |
| Tin-plates, I.C., 20 by 14 f.o.b. | 15/0 to 15/6 |
| Block Tin (cash) | 143 10 0 |
| „ (three months) | 145 0 0 |
| Copper (cash) | 32 7 6 |
| „ (three months) | 33 2 6 |
| Spanish Lead (cash) | 11 17 6 |
| „ „ (three months) | 11 18 9 |
| Spelter (cash) | 14 1 3 |
| „ (three months) | 14 6 3 |
| Manchester— | |
| Copper, Best Selected Ingots | 36 0 0 |
| „ Electrolytic | 37 0 0 |
| „ Strong Sheets | 62 0 0 |
| „ Tubes (Basis Price), lb. | 0 0 10 |
| Brass Tubes (Basis Price), lb. | 0 0 9 |
| „ Condenser, lb. | 0 0 11¼ |
| Lead, English | 14 0 0 |
| „ Foreign | 12 5 0 |
| Spelter | 14 10 0 |
| Aluminium (per ton—raw ingot) | £95 |

## FERRO ALLOYS.

| | Per Ton. | Per Unit. |
|---|---|---|
| Tungsten Metal Powder | 2/– per lb. | |
| Ferro Tungsten | 1/9 per lb. | |
| Ferro Chrome, 4 p.c to 6 p.c. carbon | £25 0 0 | 8/– |
| „ „ 6 p.c. to 8 p.c. | £24 10 0 | 7/6 |
| „ „ 8 p.c. to 10 p.c. | £23 15 0 | 7/– |
| „ „ Specially Refined | | |
| „ „ Max. 2 p.c. carbon | £37 0 0 | 11/– |
| „ „ „ 1 p.c. carbon | £47 0 0 | 14/– |
| „ „ „ 0·70 p.c. carbon | £48 0 0 | 16/– |
| „ „ „ carbon free | 1/1 per lb. | |
| Metallic Chromium | 2/9 per lb. | |
| Ferro Manganese (per ton) | £11 0 0 for home | |
| „ „ „ | £11 10 0 for export | |
| „ Silicon, 45 p.c. to 50 p.c. | £13 10 0 scale 5/– per unit | |
| „ „ 75 p.c. | £19 0 0 scale 6/– per unit | |
| „ Vanadium | 12/6 per lb. | |
| „ Molybdenum | 6/3 per lb. | |
| „ Titanium (carbon free) | 9d. per lb. | |
| Nickel (per ton) | £250 to £255 | |
| Ferro Cobalt | 8/– per lb. | |

## FUELS.

### SCOTLAND.

| | Export. |
|---|---|
| Lanarkshire— | |
| (f.o.b. Glasgow)—Steam | 13/– |
| „ „ Ell | 14/– |
| „ „ Splint | 13/9 to 14/9 |
| „ „ Trebles | 13/– to 13/6 |
| „ „ Doubles | 11/6 |
| „ „ Singles | 10/– |
| Ayrshire— | |
| (f.o.b. Ports)—Steam | 11/6 |
| „ „ Jewel | 16/6 |
| „ „ Trebles | 13/– to 13/3 |
| Fifeshire— | |
| (f.o.b. Methil or Burntisland)—Steam | 10/3 to 12/6 |
| Screened Navigation | 16/6 |
| Trebles | 14/6 to 15/6 |
| Doubles | 12/– |
| Singles | 10/– |
| Lothians— | |
| (f.o.b. Leith)—Best Steam | 11/– to 11/6 |
| Secondary Steam | 10/6 |
| Trebles | 13/– to 13/3 |
| Doubles | 11/6 |
| Singles | 9/9 to 10/– |

### (8) N.W. Coast— ENGLAND.

| | |
|---|---|
| Steams | 21/9 |
| Household | 32/6 to 51/6 |
| Coke | 19/– to 22/6 |
| Northumberland— | |
| Best Steams | 13/6 |
| Second Steams | 12/3 to 12/6 |
| Steam Smalls | 8/6 |
| Unscreened | 12/6 to 13/– |
| Household | 27/– to 39/– |
| Durham— | |
| Best Gas | 14/6 |
| Second | 13/3 to 13/6 |
| Household | 25/– to 37/– |
| Foundry Coke | 24/– |

| Sheffield— | Inland. | |
|---|---|---|
| Best Hand-picked Branch | 25/– to 26/– | — |
| South Yorkshire Best | 20/– to 21/– | — |
| Derbyshire Best House | 20/– to 21/– | — |
| Derbyshire Best Brights | 17,– to 18/– | — |
| Screened House Coal | 15/– to 16/– | — |
| Kitchen Coal | 14/– to 15/6 | — |
| Best Screened Nuts | 15/– to 16/– | — |
| Small Screened Nuts | 13/6 to 15/6 | — |
| Yorkshire Hards | 16/– to 18/– | — |
| Derbyshire Hards | 16/– to 18/– | — |
| Rough Slacks | 8/6 to 9/6 | — |
| Nutty Slacks | 7/– to 8/6 | — |
| Blast-furnace Coke (Inland) | 9/6 to 9/9 on rail at ovens | |
| Furnace and Foundry Coke (Export), f.o.b., 13/6 to 15/6 | | |

### (9) SOUTH WALES.

| Cardiff— | |
|---|---|
| Steam Coals: | |
| Best Smokeless Large | 19/6 to 19/9 |
| Second Smokeless Large | 18/9 to 19/6 |
| Best Dry Large | 19/– to 19/6 |
| Ordinary Dry Large | 17/9 to 18/3 |
| Best Black Vein Large | 18/3 to 18/6 |
| Western Valley Large | 17/9 to 18/– |
| Best Eastern Valley Large | 17/7½ to 17/9 |
| Ordinary Eastern Valley Large | 17/3 to 17/6 |
| Best Steam Smalls | 13/– to 13/6 |
| Ordinary Smalls | 11/– to 13/– |
| Washed Nuts | 19/– to 25/– |
| No. 3 Rhondda Large | 19/6 to 19/9 |
| „ „ Smalls | 15/– to 16/– |
| No. 2 „ Large | 17/– to 17/3 |
| „ „ Through | 15/6 to 16/– |
| „ „ Smalls | 14/– to 14/3 |
| Foundry Coke (Export) | 22/6 to 36/6 |
| Furnace Coke (Export) | 17/– to 18/– |
| Patent Fuel | 20/– |
| Pitwood (ex ship) | 23/– to 23/6 |
| Swansea— | |
| Anthracite Coals: | |
| Best Big Vein Large | 36/– to 38/6 |
| Seconds | 27/– to 32/6 |
| Red Vein | 22/6 to 27/6 |
| Machine-made Cobbles | 41/6 to 48/6 |
| Nuts | 40/– to 48/6 |
| Beans | 28/6 to 32/6 |
| Peas | 19/6 to 21/– |
| Breaker Duff | 8/6 to 9/6 |
| Rubbly Culm | 11/– to 11/9 |
| Steam Coals: | |
| Large | 20/– to 20/6 |
| Seconds | 18/– to 20/– |
| Smalls | 11/6 to 13/– |
| Cargo Through | 16/– to 17/6 |

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.h Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate: Joists (minimum), 22/6: Ordinary Ship, Bridge, and Tank Plates and Sections, 15/– if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country Stations.

# French Engineering Notes.

(*From our own Correspondent in Paris.*)

### The Steel Cartel.

The fate of the Steel Cartel has been for many months in the hands of two producers in Belgium who held out for a bigger share of the national quota of production than could be allotted them, and until the Belgian industry is able to come to an agreement there is no means of realising the Pact for a restricted production and sales organisation which has been accepted by other Continental countries. Belgian steelmakers have suffered particularly from a want of internal harmony, for the partial closing of their principal market has obliged them to look elsewhere for the disposal of steel, and they are met by import quotas which tend to eliminate them from competition. At the same time, so long as the steel trade is not organised French producers have no reason to abstain from offering steel at very low prices, even in Belgium. If anything is to be done to help the steel industry the Cartel must be revived on its new basis without further loss of time. Steelmakers in the Grand Duchy of Luxemburg, which forms an economic union with Belgium, have been doing their best to smooth over difficulties, apparently with some success, for it is announced that there is a prospect of the Pact being signed in the coming month. At the same time, great efforts are being made to extend the scope of the Cartel by securing the collaboration of British steelmakers.

### Road and Rail Traffic.

Monsieur Javary, traffic manager of the Compagnie du Chemin de Fer du Nord, has explained in a conference before the Office des Transports and Chambers of Commerce the general lines of a plan for meeting road competition which has been submitted for approval to the Ministry of Public Works. He dealt with two particular cases which illustrate the problem as a whole. Between Lille and Paris a 10-ton lorry will collect and deliver goods at a cost of 100f. a ton. The railway company cannot do that unless it is assured of carrying a daily average of 100 tons, and, moreover, the goods would have to be collected and delivered by lorries. In order to realise those conditions the Nord system has been divided into seventeen zones, in each of which there will be a service of motor lorries, so that the customer will have the advantage of a door-to-door service and of safe transport by rail. The local railways involve a heavy loss because the railway companies are required by the State to run a certain number of trains a day, whether there is any traffic or not, and they will, therefore, have to be suppressed and replaced by motor road vehicles. Lorries and omnibuses will deal with local traffic and will also carry goods and passengers to and from "centre stations" on the railway. This is an adaptation of the radial traffic system which Monsieur Javary has long been advocating. It will be rather a costly organisation, which will have to be met by a further tax on traffic, but it is argued that the customer will find an economy in having the goods delivered at his door, while the Compagnie du Nord will effect a saving of something like 200 million francs a year.

### The Port of Paris.

Paris is the leading French port as regards tonnage of water-borne traffic, consisting exclusively of coal, timber, oil, wine, and bulky material of all kinds by way of canals and rivers which are being improved to constitute a particularly complete and efficient inland waterway system. The port itself has been considerably extended by the new basin and docks at Pantin to deal with traffic from the North of France and by the new port at Gennevilliers. A peculiar feature of this traffic is that it is all one way. Boats arrive in Paris with loads and return empty. The port of Gennevilliers was created in view of the work being carried out to facilitate navigation between Rouen and Paris, which is at present impeded by nine locks and by an insufficient depth of water, and it was hoped that the works being undertaken would have allowed of fairly large cargo boats reaching the capital. While the removal of obstructions and the building of new barrages below Paris have regularised the Seine, it is hardly likely that boats drawing more than 3 m. will be able to ascend the river at all times; but the navigation will, nevertheless, be greatly improved, and Rouen will become, more than it is at present, the port of transit to Paris. A couple of locks will be suppressed by the recent completion of a new one below Elbeuf, with two basins 200 m. long and 17 m. wide.

### Polish Coal.

An agreement has been reached between France and Poland whereby the latter country will be allowed to ship to France 100,000 tons of coal a month in return for advantages, notably the removal of the embargo upon certain French products into Poland. This arrangement, apparently, changes the character of the import quotas which were applied equally to all coal-producing countries in order to avoid giving to them a discriminating character. To all intents and purposes, existing treaties of commerce with their most favoured nation treatment have broken down, and there can be no hope of trade recovery until they are replaced by new treaties permanently fixing the conditions under which trade can be carried on.

### Foreign Trade.

The returns of foreign trade during the first seven months of the year show that exchanges continue on the down grade. The imports were valued at 17,667 million francs, a decline of 9166 million francs as compared with the corresponding period of 1931, while the exports amounted to 11,512 million francs, which is 7129 million francs less than they were a year ago. The value of manufactured goods exported was 7121 million francs, a decline of 4528 million francs. The imports of coal declined in the same period from 17,290,409 tons to 12,154,131 tons. The contraction of imports was about 34 per cent. and of exports rather more than 38 per cent.

# British Patent Specifications.

*When an invention is communicated from abroad the name and address of the communicator are printed in italics.*

*When an abridgment is not illustrated the Specification is without drawings.*

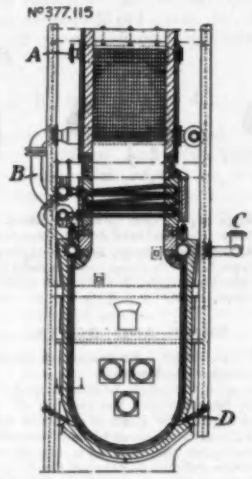
*Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.*

*The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.*

## STEAM GENERATORS.

377,115. February 6th, 1932.—Superheaters, *Babcock and Wilcox, Ltd., Babcock House, Farringdon-street, London, E.C.4.*

This is a separately fired superheater, presumably intended for oil firing. Saturated steam enters at A, passes through the upper bank of tubes and then by the transfer pipe B to the intermediate bank, which it enters at the bottom. It is suggested that the lower tubes should be made of a heat-resisting alloy,

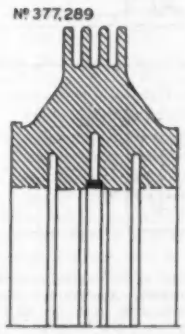



as they are subject to the direct action of the flames. The steam then goes on to the U-shaped superheater, which forms the combustion chamber and emerges at C. The U-shaped tubes are protected by a refractory coating. The various parts are supported from an outside framing by links of a heat-insulating character, to check the unnecessary dissipation of heat. The supports at D embody springs to permit expansion and contraction.—*July 21st*, 1932.

## TURBINE MACHINERY.

377,289. April 24th, 1931.—Turbine Discs, R. W. Bailey, 20, Grange-avenue, Hale, Cheshire, and Associated Electrical Industries, Ltd., Crown House, Aldwych, London, W.C.2.

It is explained that the bosses of turbine discs are liable to develop hair cracks during thermal treatment. The inventor

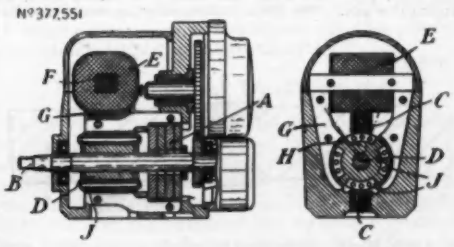



consequently machines one or more grooves, as shown in the drawing, so that the interior of the boss can be inspected. The grooves may be cut either before heat treatment or after the completion of the machining, or one groove may be cut before and others after heat treatment.—*July 25th*, 1932.

## DYNAMOS AND MOTORS.

377,551. December 10th, 1931.—Induction-magneto Electric Machines, Robert Bosch Aktiengesellschaft, of 4, Militärstrasse, Stuttgart, Germany.

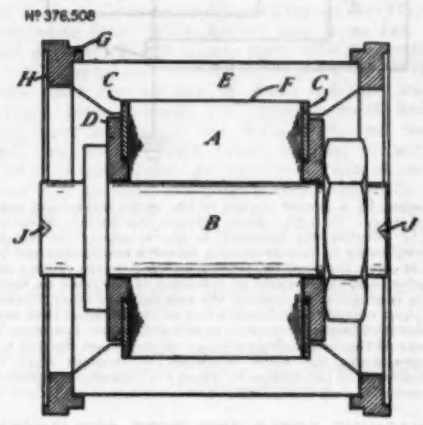
The induction magneto described in this specification consists of a stationary magnet composed of several flat bar magnets,




having in the centre an opening for the passage of the shaft B. The pole shoes C of the magnet extend parallel to the shaft over the rotating flux conducting piece D. A winding E is provided on the core F of the armature, which is also stationary, and to the core the pole shoes G of the armature are connected. The armature pole shoes extend so far round the conducting piece D that the terminal edges of the pole shoes C of the magnet and of the armature subtend an angle H at the centre of the conducting piece D, which is approximately equal to 360 deg. divided by the number of cylinders of the engine with which the magneto is to be used. The number of the segments J on the conducting piece for the lines of force is half as great as the number of cylinders of the engine. The segments on the circumference of the conducting piece are of such a length that they extend around the flux path guide piece from the trailing edge of the one armature pole shoe to the leading edge of the other succeeding armature pole shoe in the direction of rotation. By this means the magnetic flux in the magnet is never interrupted, and the magnet does not become weakened. In the operation of the magneto two segments J only are simultaneously traversed by the magnetic flux, whilst the other segments remain out of action.—*July 28th*, 1932.

376,508. July 21st, 1931.—Method of Constructing the Stator of Electrical Machines, *William Edward Evans, of 27, Chancery-lane, London, W.C.2.*

It is cutomary to machine the casings of dynamo-electric machines on a lathe before inserting the metal plates within them. Furthermore, with machines with casings in skeleton form, the insertion of the plates is left until the skeleton has been constructed. This procedure is, however, in many cases inconvenient, particularly with small machines, for the reason that the plates must be fitted in a cylindrical space, in which it is difficult to handle the tools and the parts to be secured. Moreover, there is frequently difficulty in fixing the casing in the chuck

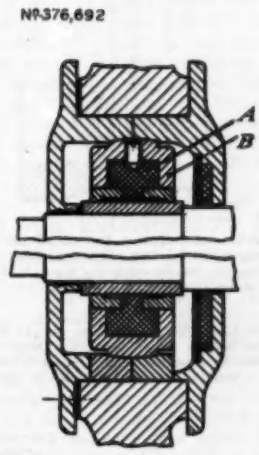



of the lathe. The object of the invention is to avoid these disadvantages. The stator plates A are placed on a rod B between pressure plates C with gripping members D, which hold the whole set of plates together temporarily. The bars E, recessed at F, are then placed in position around the set of plates and held in place by rings G, when they are fixed together at their ends. The whole frame, with the stator plates, is placed on a machine tool and the surfaces H of the bearing plate turned. The work of fixing and centrally machining the structure is simplified by the centring holes J, previously made in the rod B. When the clamping members have been loosened and the rod removed, the plates remain securely held in the recesses F by the bars E acting as clamps.—*July 14th*, 1932.

## TRANSMISSION OF POWER.

376,692. April 11th, 1932.—Journal Bearings, Siemens-Schuckertwerke Aktiengesellschaft, Berlin-Siemensstadt, Germany.

This invention hints at a reversion from roller bearings to plain journal bearings, as it is said that the bearing "can be used in the place of roller bearings without alteration to the



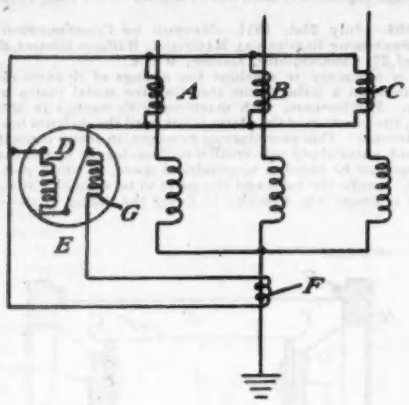

housing." The claim is for a journal bearing for use in place of roller bearings, and in which lubrication is by means of a wick surrounding the shaft, characterised in that the wick is contained in a U-shaped ring, which is arranged to support the shaft. In the drawing A represents the wick and B the U-shaped supporting ring. Arrangements are provided for supplying the wick with lubricant.—*July 14th*, 1932.

377,230. April 22nd, 1931.—Electric Protective Arrangements, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C.2; and Paul Mathews, of 7, Bilton Rise, Rugby.

This invention relates to the protection of polyphase electrical apparatus against faults to earth, and particularly to the protection of transformers, generators, &c., which are deliberately earthed at one point, usually the neutral point, in order to supply a path for earth fault currents on the system to which they are connected, or for other reasons. The object of the invention is to provide an improved means for disconnecting such apparatus under earth fault conditions which is sensitive and will not respond to through earth fault currents. The secondary windings A B C of the phase current transformers are connected in parallel and to the current coil D of the directional wattmeter type relay E, while the earth connection current transformer secondary winding F has one terminal connected to one of the terminals of the current coil D of the relay. The other terminal is joined to one end of the other relay coil G, the other end of that coil being connected to the terminal of the current coil of the

relay which is remote from the terminal connected to the earth connection current transformer. By this arrangement the load on the phase current transformer is reduced, as the current coil of the relay will require less V.A. than in the case of a simple relay having a similar movement, owing to the presence of the second coil which is energised from the earth connection current transformer. This reduction in load brought about by reducing the magnetising current required by the phase current transformers when operating the relay reduces the primary fault current necessary for this purpose, and in this way a tendency to high magnetising current, otherwise unavoidable, can be

Nº 377,230



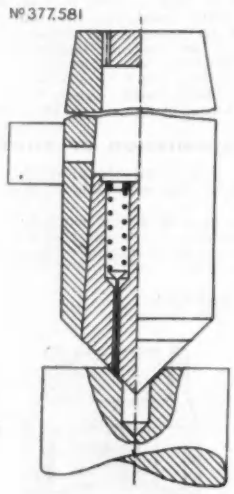

remedied by a proper design of the earth connection current transformer. In high-voltage practice this current transformer can be conveniently increased in size to supply the necessary output, owing to its surrounding an earth connection and being free of other practical limitations imposed on the phase current transformers. Prevention of operation of the relay on through faults is attained by making the nominal secondary current of the phase current transformers just so much higher than that of the earth current transformer as will nullify the operative component of the magnetising current of the phase current transformers under the worst condition of through earth fault encountered on the system to which the protective apparatus is connected.—*July 22nd*, 1932.

## MACHINE TOOLS AND SHOP APPLIANCES.

377,581. February 5th, 1932.—Lathe Centres, F. Bolanz, Weil-on-the-Rhine, Otterbach, Germany.

This dead centre is provided with an internal lubricating chamber and a needle valve. The needle is arranged excen-

Nº 377,581



trically, so that it bears against the coned part of the centre hole. The arrangement has the advantage over the more usual system of placing the needle centrally that the needle need not project so far, and consequently is less liable to damage.—*July 28th*, 1932.

377,142. March 31st, 1932.—Bending Metal Tubes, Mannesmannröhren-Werke, Is, Berger Ufer, Düsseldorf, Germany.

If it is desired to produce a tube bend of which the outer diameter of the tube is 57 mm., a tube of outer diameter of

Nº 377,142

Fig. 1

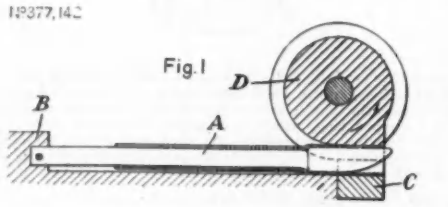
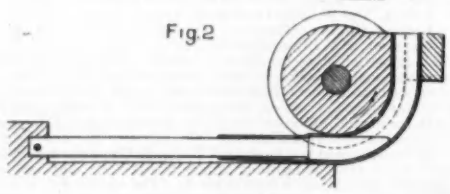



Fig. 2



54 mm. and of suitable thickness is expanded at one end for a distance which corresponds to the length of the spoon-shaped head of the mandrel A. The mandrel is then introduced into the tube so that its head is located in the expanded portion in the manner shown in Fig. 1 and the tail of the mandrel is secured at B. The expanded end of the tube is clamped to to the roller D by the clamp C, and the roller is rotated in the direction of the arrow to draw the tube over the head of the mandrel. During the drawing process, the inside material of the tube is drawn and expanded over the edge of the mandrel head, and the metal at the inside of the bend becomes tensioned to such an extent that as the tube is bent over the roller an accumulation of material and the formation of folds upon the inside of the bend is prevented. Fig. 2 illustrates the position of the roller and tube relatively to the mandrel after a 90 deg. bend has been produced in the tube. By the method according to the invention, it is possible to produce bends in tubes with the smallest radii with or without straight extensions upon either end of the bend, and, moreover, the tubes may be bent in the cold state.—*July 21st*, 1932.

## TRAMWAYS AND RAILWAYS.

377,571. January 25th, 1932.—Pneumatic Tires for Railways, Michelin et Cie., Clermont Ferrand, Puy de Dome, France.

This pneumatic tire for railway work is practically flat, and the side walls of the air chamber are formed by the rim, while

Nº 377,571

Fig. 1

Fig. 2

Fig. 3

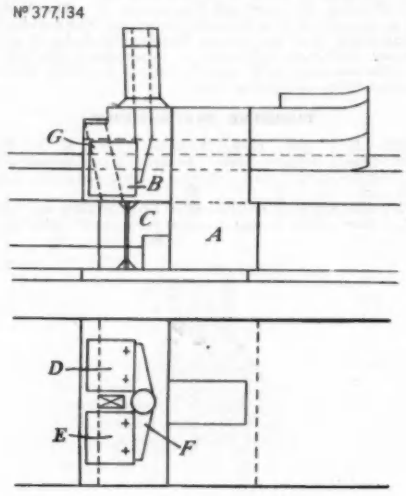
a metal guide flange is provided by an extension of the rim. As shown in Fig. 1, the tire is inflated by an inner tube. As shown in Figs. 2 and 3, there is no tube, and air-tightness is secured by soft rubber flaps A A. In these cases a safety support B can be arranged to take the weight in the event of the tire becoming deflated.—*July 28th*, 1932.

## SHIPS AND BOATS.

377,134. March 7th, 1932.—Bunkers of Steamships, K. G. Meldahl, Fredrikstad, Norway.

In steamships with the main boilers mounted on a deck or platform at some height above the bottom of the ship, or the tank top, so that a utilisable space is obtained below the boiler-room, it is as a rule advantageous to use this space for bunkers, auxiliary machinery, or the like, as if the space is used as a cargo hold it is often difficult to arrange the cargo hatch as near to the end bulkhead of the space as desirable. Where the space is used as coal bunkers the boilers prevent the arrangement

Nº 377,134




of the bunker hatches or trunks in such manner as to effect easy filling of the bunkers. According to the present invention, this difficulty is avoided in that one or more bunker trunks are carried down between the boilers, which are located at a somewhat greater distance from one another than is usual. In the drawing, A is the engine-room, B the boiler-room, and C the bunker below the same. As shown, the boilers D and E are placed at some distance from one another, with an extended uptake F, and the filling trunk G is carried down between the boilers centrally of the bunker.—*July 21st*, 1932.

## WELDING.

377,576. January 28th, 1932.—The Welding of Iron, Steel, and their Alloys, Fried. Krupp Aktiengesellschaft, Essen, Germany.

This invention relates to welding iron, steel and their alloys using electrodes or welding rods of the composition of the chemically neutral chromium-nickel steel alloys for welding ingot iron, gray cast iron, cast steel, cast silicon steel, and structural steels. The term "chemically neutral chromium-

Nº 377,576

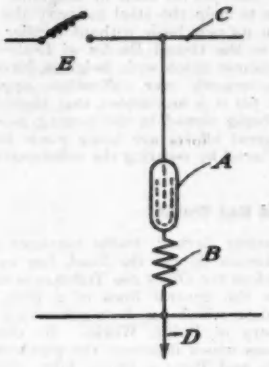
nickel steel alloys" is intended to include all those alloys which are either resistant to corrosion by the chemical attack of the atmosphere, acids, and so forth, or are resistant to oxidation at high temperatures, or both. The strength of the weld produced by the use of such electrodes is often greater than that required. According to the invention, only one or more layers of the weld, and not the whole thereof, is made from the chemically neutral chromium-nickel steel alloy. This method makes it possible to graduate the strength of the weld in any desired manner and to economise in material, since the consumption of expensive chromium-nickel steel welding rods can be limited. Furthermore, by forming the outer layers by the chromium-nickel steel welding rods, welds can be produced having considerable resistance to chemical attack. The interior of the weld is made of ordinary mild steel.—*July 28th*, 1932.

## MISCELLANEOUS.

377,188. January 16th, 1931.—Apparatus for the Protection of Electric Conductors Against Excess Voltage, Sigwart Ruppel, of 8, Palmengartenstrasse, Frankfurt-on-Main, Germany.

Various arrangements are described in this specification for the protection of electrical conductors against excess voltages, and the accompanying diagram shows one of them. The excess voltage protective device consists of the discharge tube A and the ohmic resistance member B. The series circuit consisting of the discharge tube and the ohmic resistance is placed between

Nº 377,188




the external conductor C of a branch network and the earthed conductor D. An overload or excess current switch E is provided in the conductor C. Excess voltages up to a certain magnitude and time of duration are led away by the tube A and the ohmic resistance B without the switch E responding. If excess voltages of extremely long duration or extreme magnitude occur, then the release of the excess current switch E is brought about as a result of the large current flowing away through the tube A and the ohmic resistance B. There are seven other illustrations.—*July 18th*, 1932.

# Forthcoming Engagements.

*Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Tuesday of the week preceding the meetings. In all cases the* TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY TO MONDAY, SEPTEMBER 19TH.

Institution of Mechanical Engineers.—Summer visit to Canada.

TUESDAY TO SATURDAY, AUGUST 30TH TO SEPTEMBER 3RD.

Institut International de Documentation.—Frankfurt-am-Main. Eleventh conference. For details see page 148.

WEDNESDAY, AUGUST 31ST, TO WEDNESDAY, SEPTEMBER 7TH.

British Association for the Advancement of Science.—Annual meeting at York. President, Sir J. Alfred Ewing, F.R.S. Particulars may be obtained on application to the secretary, British Association, or to the hon. local secretaries, British Association, The Guildhall, York.

WEDNESDAY, SEPTEMBER 7TH.

Manchester Association of Engineers.—Visit to the Lancashire Steel Corporation, Ltd., Irlam. Assemble at the works at 2 p.m.

SATURDAY, SEPTEMBER 10TH.

Belfast Association of Engineers.—Visit to the Baun Drainage Scheme and trip to Portrush. Leave City Hall, Belfast, 1.15 p.m.

Institution of Municipal and County Engineers.—Eastern District meeting to be held at Great Yarmouth. Assemble at Town Hall, Great Yarmouth, 10.30 a.m.

MONDAY, SEPTEMBER 12TH.

Institute of Metals.—At the Institution of Mechanical Engineers, Storey's-gate, Westminster, S.W. 1. Annual autumn lecture, "Corrosion Fatigue in Metals," by Dr. H. J. Gough. 8 p.m.

MONDAY TO THURSDAY, SEPTEMBER 12TH TO 15TH.

Iron and Steel Institute and Institute of Metals.—Joint autumn meeting in London. For programme see page 119.

TUESDAY, SEPTEMBER 13TH.

Institute of Marine Engineers.—85, The Minories, E.C.3. Presidential Address. Commander C. W. Craven, R.N. (retd.). 6 p.m.

TUESDAY TO SATURDAY, SEPTEMBER 13TH TO 17TH.

International Foundry Congress.—Paris.

SATURDAY, SEPTEMBER 24TH.

All-British Exhibition.—Copenhagen, Denmark, Opening.

WEDNESDAY, SEPTEMBER 28TH.

Belfast Association of Engineers.—Belfast. Inspection of new laundry, Poor Law Union. 7.30 p.m.

# A Seven-Day Journal

## The Sale of Gas in 1931.

THE Board of Trade Returns for 1931, which relate to 749 undertakings authorised to manufacture and supply gas, have just been issued. They show an increased sale of gas during the year under review. The total number of therms sold by all undertakings was 1,389,826,798. The quantity of gas made, including that bought from coke ovens, was 313,753,000,000 cubic feet, being 767,000,000 cubic feet more than in 1930; while the quantity sold increased by 702,000,000 cubic feet, or 0·2 per cent. compared with the preceding year. There was a decrease of 986,000,000 cubic feet, or 0·4 per cent., in the amount of coal gas made, but the quantity of water gas manufactured increased by 1,278,000,000 cubic feet, or 3·2 per cent. This is clearly shown by the 242,000 tons less coal carbonised compared with 1930, and the increase of 4,051,000 gallons in the oil used in the manufacture of water gas. There was also a falling-off in the residuals, the coke and breeze being 181,000 tons less and the tar 2,080,000 gallons less than in 1930, while the sulphate of ammonia also fell in quantity by 22,400 tons. The number of consumers increased by 214,395, or 2·3 per cent., and now amounts to a total of 9,858,229. The quantity of gas bought from owners of coke ovens and distributed by statutory gas undertakings was 13,923,000,000 cubic feet, 5·5 per cent. more than in 1930.

## Caisson for Southampton Dock.

ON Monday last the Southern Railway Company announced that it had placed an order with the Furness Shipbuilding Company, Ltd., of Haverton Hill-on-Tees, for the sliding caisson which will close the entrance to the new graving dock now being constructed at Millbrook, Southampton. The caisson, which will be one of the largest ever built, is to be of the double-faced type, in the building of which some 1500 tons of British steel will be utilised. It will have a length of 142ft. and a depth of 58ft. 6in., the width being 29ft. 6in. After its construction in the shipbuilders' yard it will be launched in readiness for towing to Southampton. On arrival at the port it will be placed in one of the dry docks, and finally completed in readiness for certain tests which are to be carried out by the dock engineers. The caisson will, it is expected, be ready to be put into position in about a year's time. Work on the graving dock itself is proceeding very satisfactorily, and there is every indication that all the main work will be finished well within the contract time, which expires at the end of June next year.

## The Future of the U.S. Liner Leviathan.

IT will be recalled that during last winter the flagship of the United States Lines, the "Leviathan," was laid up. According to a statement made at Southampton on Monday last by Mr. J. McCarthy, the vice-president and general manager of operations, it is very likely that this year the liner will continue her services throughout the winter months. It seems that the United States Government has intimated its wish that the liner should remain in service, and it is practically certain that her owners will accede to the Government's suggestion. They are very gratified with the results of the recent negotiations with the Government on mail subsidy questions, which arose in connection with the operation of the recently commissioned liner the "Manhattan" and her sister liner, the "Washington," now approaching completion, as they will enable the company to carry out its plans with the assurance of Government support. In these circumstances it is probable that the "Leviathan" will continue to be operated throughout the winter months, but she will most likely make Southampton her port of call and not Plymouth, as during the summer months. Whether she will dock or whether she will be dealt with in the Cowes Roads has yet to be decided. The experiment of making Bremerhaven her terminal port has proved a successful one, and it seems unlikely that any change in this arrangement will be made.

## Trade with Russia.

THE extent of this country's trade with Russia in all kinds of machinery and of machine tools is well illustrated by figures contained in the annual statement of the export trade of the United Kingdom issued last Saturday, August 27th, by the Board of Trade. The total exports of machinery to Russia in 1931 were valued at £4,417,907, as compared with a total of £19,288,381 from all foreign countries combined. France, the second largest buyer from this country, took machinery to the value of £2,050,893, or less than half the amount bought by Russia. Of the complete total of over four million pounds, £1,413,888 was expended by Russia upon the purchase of machine tools, £462,252 on steam turbines, £373,367 on steam boilers, £194,205 on electrical machinery, and £14,047 on textile machinery. The trade is carried on by a system of long-term credits guaranteed by the Government, and manufacturers are disturbed by the difficulty of obtaining these guarantees. A circular upon the question was sent out by the Manchester and Salford Trades Council last Saturday to councils and trade union branches, from which we reprint extracts below: "It is indisputable that during recent months Soviet orders to the value of £3,000,000 which were first offered to our engineering and electrical firms were subsequently transferred to other countries because the Government refused to provide the necessary guarantees. It is incontestable that there is less risk in guaranteeing Soviet bills to-day than those of any other country, because the Soviet Union is the only country in the world with which no British firm has contracted a single bad debt. In view of all the circumstances, my council trusts that your branch will communicate without delay with the Prime Minister, with your local Members of Parliament, and with your local authorities urging that the amount available for guaranteeing credits at the disposal of the Export Credits Guarantee Department should be raised to £50,000,000, and that every possible assistance should be given by that Department to British manufacturers desirous to accept Russian orders."

## Air Route to the Cape.

AN agreement has been reached between the authorities in Northern and Southern Rhodesia and the Beit Trust with regard to improvements of the air mail routes within the area covered by these territories. It is proposed that four new landing grounds shall be constructed in Southern Rhodesia, while nine, already made or now under construction, will be enlarged or completed. In the Northern territory three landing grounds will be extended. In addition, a total of seven road strips are to be cleared of trees and scrub for a sufficient width and distance to allow an aeroplane to land safely in cases of emergency. A work of the latter nature may cost between £100 and £200 compared to the expenditure of as much as £1000 for the clearing of a complete aerodrome. The total cost of the whole of the proposed work is estimated at £11,000, and its effect will be to provide landing grounds at intervals of not more than 50 miles along the route between the Tanganyika border and the Transvaal, and of less than 30 miles in Southern Rhodesia. Directional wireless apparatus is to be installed between Broken Hill and Salisbury with the object of aiding pilots undertaking cloud flying over the Zambesi Valley. At the aerodrome at Broken Hill £1400 is to be expended upon the provision of a concrete apron in front of the hangars and the construction of runways, so that the aeroplane service shall not be hampered by the bad condition of landing grounds in the rainy season.

## Technical Staffs and Post-office Reform.

THE Institution of Professional Civil Servants, which represents the whole of the professional and technical staff of the Post Office, has issued the following statement on the Report of the Bridgeman Committee of Inquiry:—The Institution cordially welcomes many of the recommendations of the Bridgeman Committee. It is particularly glad that the Committee, while paying a high compliment to the capacity of the engineering and technical staff, entirely endorses the opinion expressed to it by the Institution that under the present organisation engineering and other technical officers are not given their proper place in the formulation of policy. Although the Committee has not seen fit to recommend the separation of the Telegraph and Telephone Services from the Mails, it has adopted a number of other important reforms which were urged upon it by the Institution. Among these are the institution of a functional Board, including technical members, at headquarters; access to administrative posts for technical officers who possess administrative ability, and provision for adequate practical experience for all officers appointed to administrative posts; and the continued performance by the Office of Works and the Stationery Office of their present services for the Post Office. The Institution regards the Report of Viscount Bridgeman and his colleagues as a significant recognition of the necessity of improving the status of the technical expert in the Post Office, and it is of the opinion that the efficiency of the public service would be much enhanced if the conclusions of the Committee on this subject were extended to other Departments.

## New Industrial Development.

THE report of the Committee on New Industrial Development, set up by the Economic Advisory Council in March, 1931, under the chairmanship of Mr. J. H. Thomas, was issued on Tuesday, August 30th. In summarising its conclusions the Committee states that, having examined the various arguments which have been put forward in support of the proposed establishment of a new national research organisation, as outlined in the terms of reference, it considers that such an organisation would cut right across the existing organisation of the Department of Scientific and Industrial Research, and would be likely in practice, by the confusion of purpose and distraction of effort it would cause, to injure rather than to forward the cause of scientific research in British industry. It is furthermore satisfied that the existing Government organisation for the promotion of industrial research is efficient, and is sufficiently flexible to enable it to develop along such lines as may be desirable to meet the changing needs of industry. The Committee is, therefore, unable to recommend the establishment of a new national organisation along the lines suggested. Dealing with research associations it is stated that the evidence which has been received shows clearly how valuable are the services rendered to industry by the research associations established by particular industries, and it trusts that it will be possible for his Majesty's Government to continue to provide financial assistance to these bodies on a scale sufficient to enable them to function effectively until such time as industry is in a position to bear the whole of their cost.

## The Model Engineer Exhibition.

THE Exhibiton of Model Engineering, which is organised annually by Mr. Percival Marshall, of the *Model Engineer*, was opened yesterday at the Royal Horticultural Hall, Westminster, and is as full of interest as ever. It will remain open until September 10th. We gained the impression, on going round the exhibits, that the makers of small machine tools and hand tools suitable for amateur work have revived their interest in the Exhibition, and that several new makers have taken up the industry. A number of new models are exhibited, both in competition and on loan, and among them the pride of place is taken by a miniature replica of the "Rocket" made in silver by Dr. Winter. It is exact in every detail, even down to the number of rivets in the boiler, and its making occupied some 8000 hours. Dr. Winter also shows a most ingenious calendar, which cannot be set to indicate an incorrect date without a bell ringing—that is to say, the name of the month, the number of the day, and the name of the day must always be correct. Model speed-boats, sailing boats and aviation are all well represented.

## The Cruiser Orders.

ON Wednesday, August 31st, the Admiralty announced that it had allocated the contracts for the three first-class cruisers authorised in the 1931 programme, work connected with which should have been started in March last, but had to be postponed on grounds of economy. The machinery for the two 7000-ton "Leander" class cruisers, the "Amphion," to be built at Portsmouth Dockyard, and the "Arethusa," to be constructed at Chatham Dockyard, is to be supplied by William Beardmore and Co., Ltd., of Dalmuir, and the Parsons Marine Steam Turbine Company, Ltd., of Wallsend-on-Tyne respectively. The order for the 5450-ton cruiser "Ajax," both hull and machinery, together with the armaments, has been placed with Vickers-Armstrongs, Ltd., of Barrow-in-Furness. In speaking at the launch of the submarine "Porpoise" on Tuesday last, Commander Craven said that the "Ajax" order would be good news to many people for the coming winter. It would represent £300,000 in wages at Barrow, and £400,000 elsewhere, and would provide work for 2000 people for the next two and a-half years. The contracts connected with the 1931 programme, relating to eight destroyers, two submarines, and two small minesweepers, all of which are to be constructed in private yards, have still to be allocated. The 1932 programme will not be begun until March next year.

## Rolling Mill Equipment for India.

IT is announced that the British Thomson-Houston Company, Ltd., Rugby, has just received an order from Associated Electrical Industries (India), Ltd., for a large synchronous motor, with automatic control gear, to drive a continuous sheet bar and billet rolling mill at the Jamshedpur Works, India, of the Tata Iron and Steel Company. The motor, which is to be of the totally enclosed type with closed-circuit air cooling, will be rated at 7500 H.P., 6300/3150 volts, 50 cycles, 0·8 leading power factor, 93·8 r.p.m., and will be able to take peak loads of 18,750 H.P. The motor will be the largest machine of its kind ever built in Great Britain, the diameter being 26ft., with a shaft no less than 2ft. diameter. A master controller, by means of which the operator will be able to start, stop and reverse the machine, is to be fitted. This controller will merely initiate the control, the actual starting, stopping and reversing being entirely automatic. The starting will be performed by a combination of oil circuit-breakers, auto-transformer and reactor designed to give the required starting characteristic with minimum kVA demand from the line. Quick stopping will be effected by reverse current braking. Both the motor and control gear are to be provided with full protective devices, designed to shut down the motor immediately in the event of any electrical or mechanical fault. Within twenty-four hours of the order being received the stator plates were being flame-cut in the Rugby works as a preliminary to the building up of the frame. An early delivery date was, we understand, an important element in securing the order in the face of world-wide competition.

# SWITCHING AND TRANSFORMER EQUIPMENT AT THE IRONBRIDGE POWER STATION

(*For description see opposite page*).

FIG. 25—AUTHORITIES' DISTRIBUTION AND GRID CONTROL PANELS

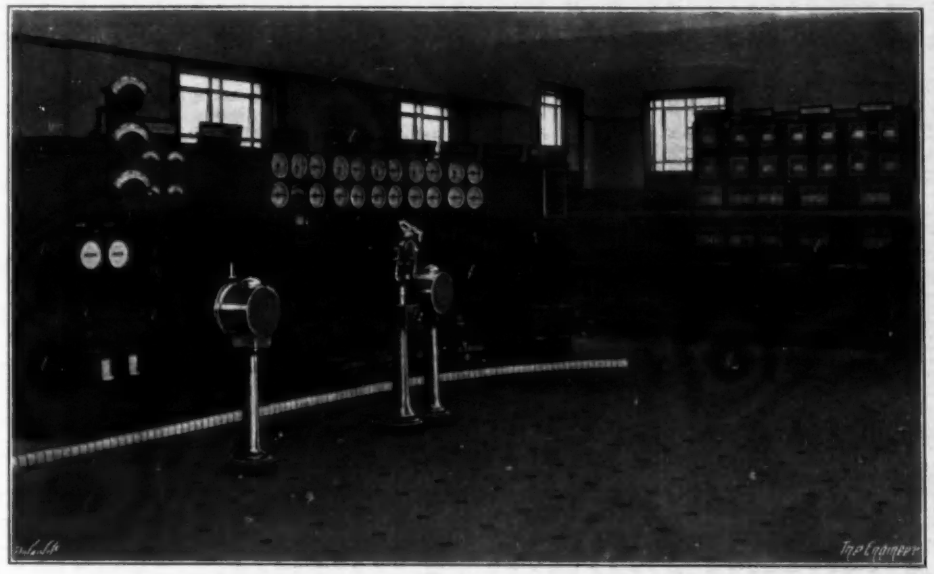


FIG. 26—GENERATOR AND GRID FEEDER CONTROL PANELS

FIG. 27—BANK OF STEP-UP TRANSFORMERS

FIG. 28—MAIN SWITCHGEAR

## The Ironbridge Power Station.

No. III. (*conclusion*).*

As the station works in parallel with others, it has been unnecessary to provide a spare generating set. The only machine that has been installed is a 50,000 kW. B.T.H. unit, although, as explained at the outset, there is space in the existing building for a second machine of the same capacity. The advantage of interconnection is also exemplified by the fact that as it is possible in the case of emergency to draw current for operating auxiliaries from the "grid" lines, it has been unnecessary to provide a house service set. Designed for a stop valve pressure of 735 lb. per square inch and a steam temperature of 750 deg. Fah., the two-cylinder, 1500-r.p.m. turbine shown in Fig. 29 works at maximum efficiency when developing 40,000 kW. In the high-pressure cylinder there are nineteen stages; in the low-pressure impulse cylinder there are eight double-flow stages. All the blades on the wheels are of stainless steel. The wheels are held in the correct position axially by a thrust block which enables the clearance to be adjusted whilst the machine is running. Governing is done by banks of nozzles which are opened fully in succession as the load increases, and the valves controlling them are operated hydraulically from a relay, operated, in turn, by the main governor. If the speed should rise above a predetermined value, the emergency governor shuts off the steam through the medium of an electro-hydraulic system. The stop valve is operated by the high-pressure oil system, upon which the supply of steam to the turbine therefore depends, and the possibility of running the set without an adequate supply of oil is avoided. A plan showing the general layout of the turbine room is given in Fig. 30.

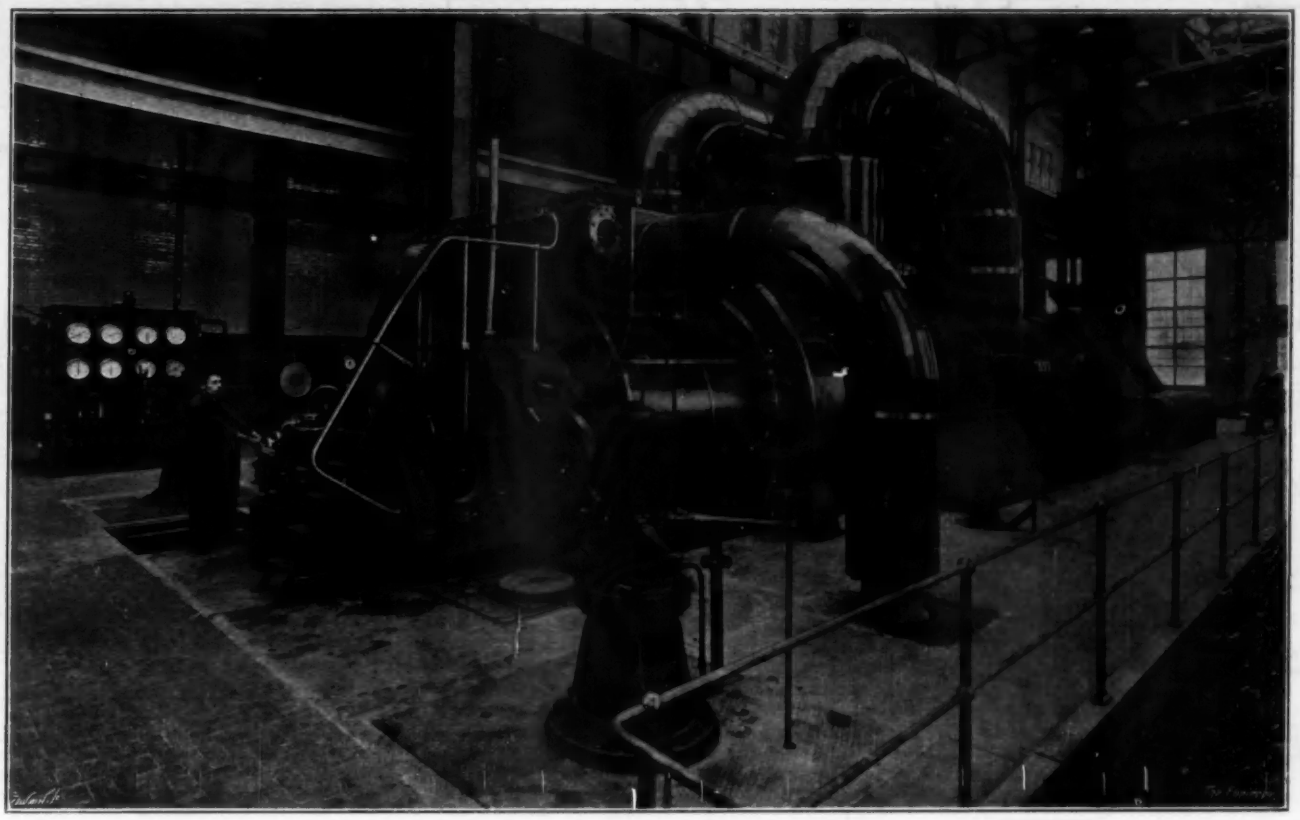


FIG. 29—50,000-kW B.T.H. TURBO-GENERATOR SET

### CLOSED FEED SYSTEM.

As is customary in these days in order to exclude oxygen from the boiler feed water, a closed feed system is employed. As shown in Fig. 31, an automatic control valve in series with the ejector outlet controls the flow of feed water through the system. Any slight excess of condensate accumulating in the condenser is discharged by the extraction pumps to the overhead feed tank. Conversely, any excess demand by the feed pumps results in the make-up water from the tank being sprayed into the vacuum space of the condenser, from which it is removed by the extraction pumps and discharged through the feed heaters to the boiler feed pumps. Thus, as the make-up water is subjected to the de-aerating influence of the condenser before passing into the system, oxygen is effectively excluded.

From Fig. 31 it will be perceived that the turbine is tapped at four points and four bled steam Hick-Hargreaves heaters operating in series with a drain cooler constitute the heating equipment of the closed feed system. The low-pressure heater and drain cooler are between the extraction pumps and boiler feed suction, whilst the high and intermediate heaters are on the pressure side of the feed pumps, and are

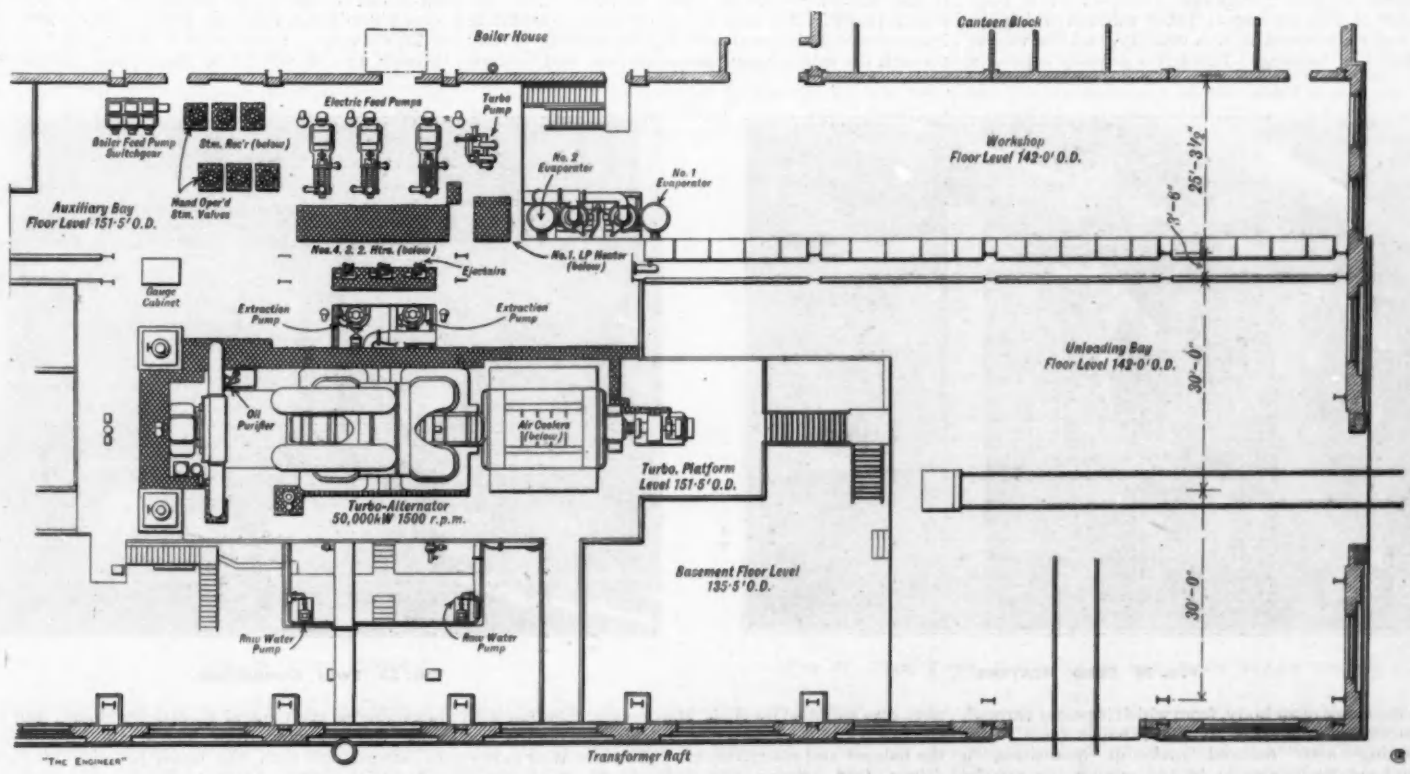



FIG. 30—PLAN SHOWING GENERAL LAYOUT OF TURBINE ROOM

* No. II. appeared August 26th.

consequently subjected to the full range pressure. These heaters, which are shown in Fig. 32, are fitted with a float-operated cut-out device, which in the event of the water level rising in the steam space of the heaters beyond a predetermined limit, automatically trips a pressure-controlled valve and so by-passes the feed water side of the high-pressure heater. The two Hick-Hargreaves evaporators to be seen on the left of Fig. 32 are normally supplied with steam from the bled high-pressure main, and each produces 15,000 lb. of vapour per hour, which is condensed in the low-pressure feed heater. The heating elements of these evaporators consist of a large number of straight copper tubes through which the raw water circulates at high velocity, and the vapour produced is discharged through a primary separator into the evaporator body, from which it passes through a secondary separator to the exhaust main. For operating with reduced make-up quantities, a secondary steam supply to the evaporator can be obtained from the intermediate bled steam range.

The Hick-Hargreaves twin condenser shown in Fig. 33 is designed to condense 294,570 lb. of exhaust steam per hour, and maintain a vacuum of 29·1in. (bar. 30in.) when supplied with circulating water at an inlet temperature of 55 deg. Fah. The total cooling surface in the two shells is 38,660 square feet. Each shell is arranged with two passes on the water side, and the tubes are arranged to give a regenerative effect in accordance with the makers' latest practice. The cast iron shells are in two parts, and the water-boxes have cast iron hinged doors with small inspection doors, which are also hinged.

Three 50 per cent. duty "Hivac" three-stage air ejectors, made by Hick, Hargreaves, are employed, each comprising three steam-operated jets working in series with intermediate and after surface coolers, the cooling medium being the condensate from the condenser. While the ejectors are situated in an accessible position of the turbine-room floor level, all the water connections are below that level. Duplicate Hivac full-duty vertical twin impeller extraction pumps (see Fig. 34), with a vertical joint to facilitate inspection of the internal parts and discharging directly through the injector condensers into the feed heaters, were also supplied by Hick, Hargreaves, together with the raw water tank, two motor-driven lift pumps, and the balance and reserve tanks. The three Weir motor-driven feed pumps, the turbo-driven feed pump, and the main steam valves above the steam receiver are shown in Figs. 36 and 37. As shown in the plan, Fig. 30, the whole of the feed-heating plant, together with the boiler feed pumps, is installed in the auxiliary bay of the turbine-room. Consequently, all this equipment is accessible to the separate crane, which runs the full length of this bay, and any portion of this plant can be dismantled with ease. The main contractors for the generating set, with its condensing plant, feed-water heating equipment, foundation steel work, high-voltage transformers, main high and low-voltage switchgear, and the pump-house equipment were the British Thomson-Houston Company, Ltd.

### ALTERNATOR.

The 62,500 kVA, 9500-volt alternator, which is directly coupled to a B.T.H. stabilised exciter consisting of two machines, generates three-phase, 50-cycle current, and is connected to the step-up transformers shown in Fig. 27 on page 224 without intervening switchgear. Three 21,000 kVA single-phase, outdoor, self-cooled transformers connected in a delta/star three-phase bank, raise the pressure from 9500 volts to 33,000 volts. Connection to the "grid" is made through two 60,000 kVA, three-phase transformers belonging to the Central Electricity Board, and these raise the pressure from 33,000 to 132,000 volts. In accordance with the usual practice in "grid" sub-stations, these extra high-pressure transformers normally work with natural cooling at about 60 per cent. full load, but when heavier loads have to be dealt with air blast cooling is brought into use. The alternator is ventilated by fans on the rotor shaft and the end shields provide air passages for the heated air, which is circulated through the B.T.H. air coolers in the foundations. A cubicle type gauge board is fitted with the usual indicating and recording instruments, including recording thermographs,

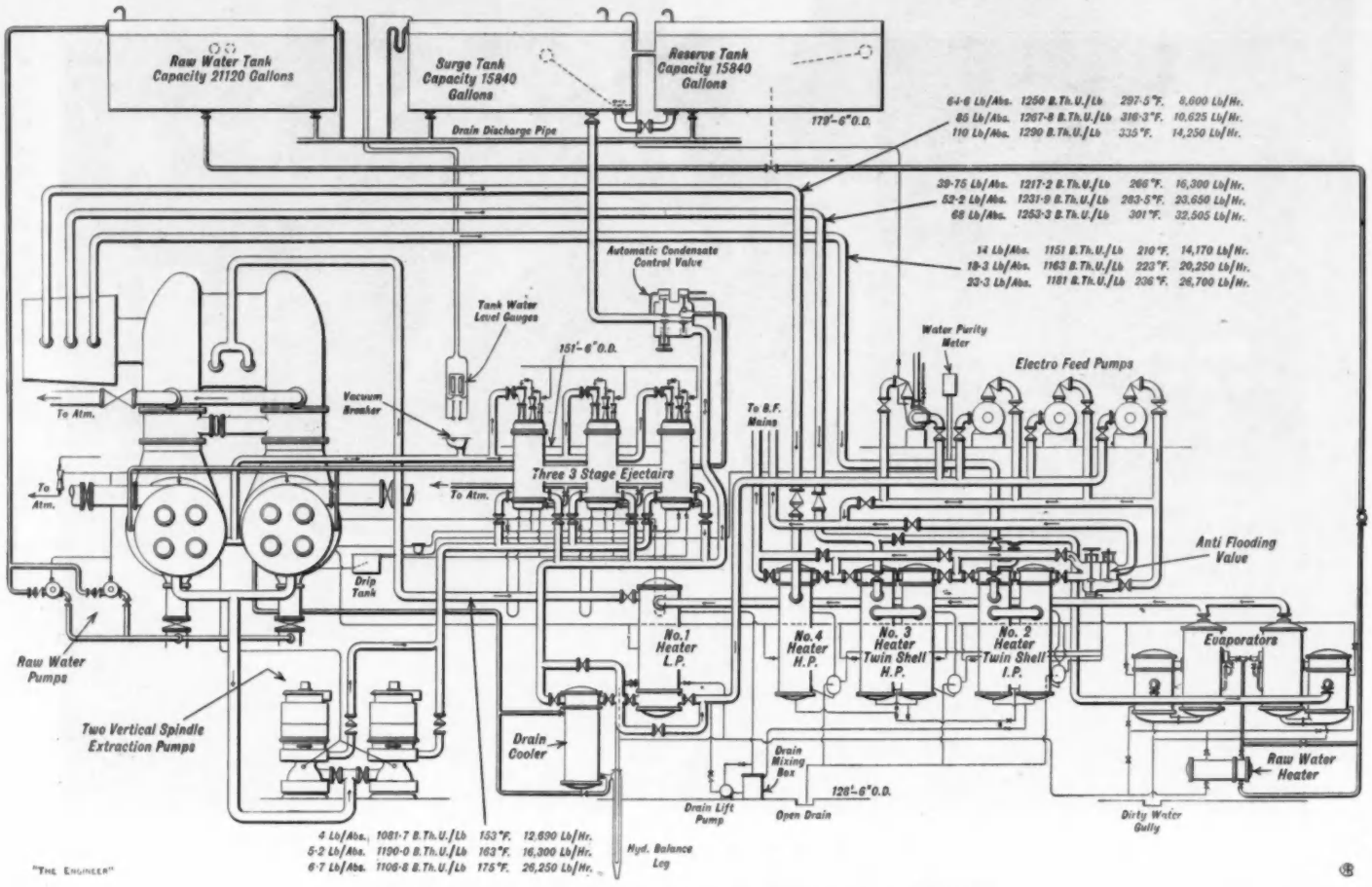

Raw Water Tank Capacity 21120 Gallons
Surge Tank Capacity 15840 Gallons
Reserve Tank Capacity 15840 Gallons
Drain Discharge Pipe
179'-6"O.D.
64-6 Lb/Abs. 1250 B.Th.U./Lb 297·5°F. 8,600 Lb/Hr.
85 Lb/Abs. 1267·8 B.Th.U./Lb 316·3°F. 10,625 Lb/Hr.
110 Lb/Abs. 1290 B.Th.U./Lb 335°F. 14,250 Lb/Hr.
39-75 Lb/Abs. 1217·2 B.Th.U./Lb 266°F. 16,300 Lb/Hr.
52-2 Lb/Abs. 1231·9 B.Th.U./Lb 283·5°F. 23,650 Lb/Hr.
68 Lb/Abs. 1253·3 B.Th.U./Lb 301°F. 32,505 Lb/Hr.
14 Lb/Abs. 1151 B.Th.U./Lb 210°F. 14,170 Lb/Hr.
19·3 Lb/Abs. 1163 B.Th.U./Lb 223°F. 20,250 Lb/Hr.
23·3 Lb/Abs. 1181 B.Th.U./Lb 236°F. 26,700 Lb/Hr.
Automatic Condensate Control Valve
Tank Water Level Gauges
151'-6"O.D.
Water Purity Meter
Electro Feed Pumps
To Atm.
Vacuum Breaker
To B.F. Mains
Three 3 Stage Ejectairs
To Atm.
To Atm.
Anti Flooding Valve
Drip Tank
No.1 Heater L.P.
No.4 Heater H.P.
No.3 Heater Twin Shell H.P.
No.2 Heater Twin Shell I.P.
Evaporators
Raw Water Pumps
Two Vertical Spindle Extraction Pumps
Drain Cooler
Drain Mixing Box
128'-6"O.D.
Raw Water Heater
Drain Lift Pump
Open Drain
Dirty Water Gully
4 Lb/Abs. 1081·7 B.Th.U./Lb 153°F. 12,690 Lb/Hr.
5·2 Lb/Abs. 1100·0 B.Th.U./Lb 163°F. 16,300 Lb/Hr.
6·7 Lb/Abs. 1106·8 B.Th.U./Lb 175°F. 26,250 Lb/Hr.
Hyd. Balance Leg
"THE ENGINEER"

FIG. 31—DIAGRAMMATIC ARRANGEMENT OF CLOSED FEED SYSTEM

FIG. 32—FEED HEATERS

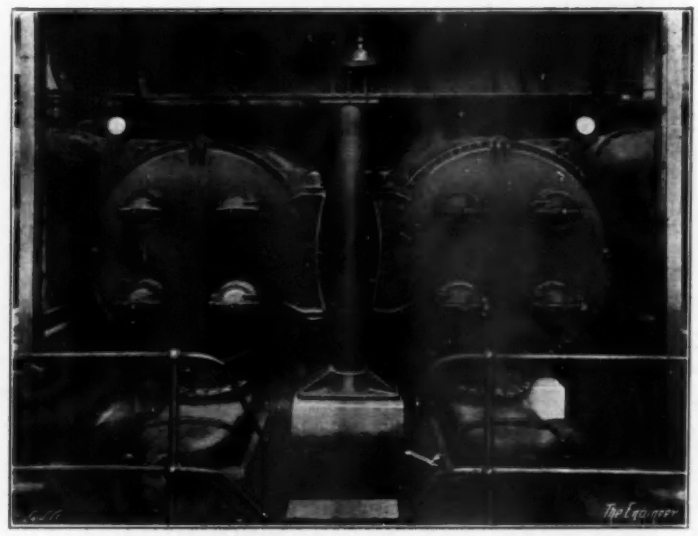


FIG. 33—TWIN CONDENSER

recording pressure and vacuum gauges, air temperature alarm gauges and multi-point temperature instruments. In the event of the temperature of the alternator rising above a predetermined value, a Klaxon horn gives an alarm. A voltage regulator of the usual field suppression type serves to control the pressure of the alternator, which may either be excited by its own direct-coupled exciter mentioned, or by another

FIG. 34—EXTRACTION PUMP

exciter driven by a 300 horse-power, 3300-volt slip-ring induction motor, this auxiliary set also serving for charging the battery.

### MAIN SWITCHGEAR.

The B.T.H. main switchgear, shown in Fig. 28 on page 224, for controlling the alternator on the secondary side of the station step-up transformers, the primaries of the grid transformers and the main group feeder has a rupturing capacity of 1,500,000 kVA at 33,000 volts. It is totally enclosed, metal-clad, drop-down gear, and while the equipment for the generator and grid transformers comprises duplicate breakers and bus-bars, that for the group feeders consists of single breakers, which may be coupled to either set of bars. When the existing station is completed and is operating, under normal conditions, two generators, two grid transformers and two group feeders will be supplied from each set of bars, thus limiting the power fed from each to half that of the installed plant capacity. The gear is of a compact unit construction. One set of bus-bars is mounted on one side of the equipment and the other set on the opposite side, as shown in Fig. 35, so that they are well separated. The bus-bar for each phase consists of insulated copper conductors enclosed in an oil-filled copper housing, and by means of suitable arrangements tee-off connections are made to the breakers. Due consideration has been given to the expansion of the bars and their enclosures, and precautions have been taken to relieve the whole of the gear from temperature stresses. Each bar is connected to an oil conservator. Separate valves are provided to enable oil to be removed from any one housing independently of the others. For each of the circuit breaker phases there is a separate chamber, which houses the instrument and protective current transformers and connects to one side of a single-core cable box by means of a trunk connector. Each of these cable boxes has a sealing off insulator so that it may be filled with the same oil as that used for impregnating the cable. The breakers are plugged vertically into or out of the service position by means of a motor-operated lifting carriage, which runs on rails throughout the length of the switchgear bank. Thus a breaker can easily be removed from one set of bus-bars to another, or may be lifted out completely for inspection. On the carriage there is a horizontal platform suspended by chains which allow freedom of movement in all directions, and when approaching the guides that are fitted to the structure for the plugging in operation the breaker is self-aligning. Each equipment has its own oil conservator, and three manifolds, one for each set of bus-bars and the other for the circuit chamber. All the gear is supported by a heavy structural steel framework at a suitable height, and perforated plates at the top form a flooring extending the full length of the gear.

### AUXILIARY SWITCHGEAR.

The auxiliary switchgear is also totally enclosed, compound-filled, metal-clad gear, with duplicate bus-bars, but is of the draw-out horizontal pattern, and is fed from the main switchgear through a group of B.T.H. reactances. Under normal operating conditions one group feeder is connected to each set of bus-bars, one of which is used for the authorities' distribution system and the other for the works supply. But, as under emergency conditions it may be necessary to change over the latter to the bar controlling the distribution, oil-immersed selector switches are provided. The B.T.H. reactors consist of three single-phase units connected as a three-phase group, with a full load capacity of 28,600 kVA, and with 5·25 per cent. impedance. All the panels for controlling the main and auxiliary electrically operated switchgear, the main rheostats and the "grid" switchgear, are situated in the control room—Figs. 25 and 26 on page 224—where there is also duplicate summation metering equipment made by Landis and Gyr, Ltd., for metering the energy as required under the Central Electricity Board scheme.

As mentioned when dealing with the boiler induced and forced draught fan motors, two systems of supply are employed for works purposes—3300 and 400/230 volts, three phase. The current at the two former pressures is controlled by duplicate switchgear in both cases. The transformers for lowering the pressure from 33,000 to 3300 consist of two 6000 kVA, three-phase units made by the Brush Electrical Engineering Company, whilst those employed for lowering the pressure from 3300 to 400 volts consist of two 1200 kVA units of the same make. Duplicate feeders have been run for the circulating water pump-house, the boiler feed pumps, and the ash-handling plant. For the boiler-house 3300-volt supplies there is a single feeder for each boiler, but by means of bus-bar coupler switches in the boiler-house any two feeders can be made to supply the whole of the current necessary for operating the three boilers. For less important circuits single feeders are provided, and the arrangement of the 400/230-volt supplies corresponds with that of the 3300-volt supplies. On the 400-volt side the Ellison switchgear consists of metal-clad units, with single bus-bars for supplying the water screen and drain pump motors, &c., and the lighting circuits connected between phase lines and the neutral. The motors driving the circulating pumps are wound for 3300 volts, like all other motors associated with the station rated above 75 horse-power. The Glenfield and Kennedy delivery and suction valves on the circulating pumps are also electrically operated.

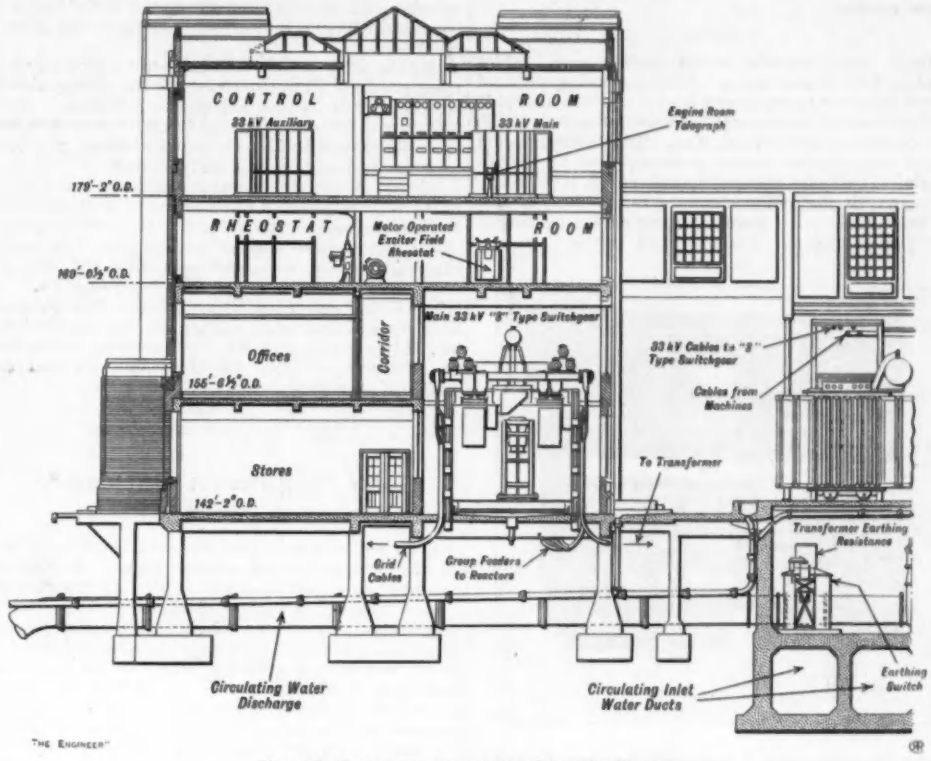



FIG. 35—SECTION THROUGH SWITCH-HOUSE

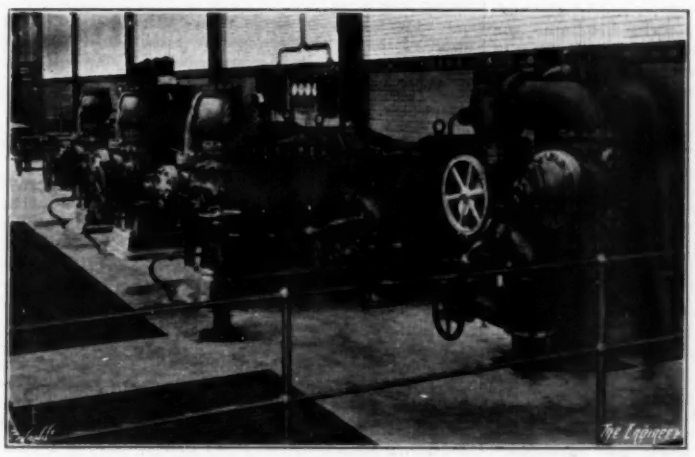


FIG. 36—FEED PUMPS

FIG. 37—FEED PUMP SWITCHGEAR AND MAIN STEAM VALVES

### AUXILIARY MOTORS.

With the exception of the standby steam-driven feed pump and nine coal feeders, which are driven by

½ H.P. variable speed D.C. motors, all the auxiliaries are operated with three-phase motors. All small machines up to 5 horse-power and all large auxiliaries having their speed varied by hydraulic couplings are provided with squirrel-cage motors, whilst in all other cases slip-ring motors are used with totally enclosed oil-immersed rotor starters made by George Ellison, Ltd. The firms which supplied the motors for driving the auxiliaries were the Metropolitan-Vickers Electrical Company and the B.T.H. Company, both of which guaranteed that the motors would not fall out of step with a sudden voltage drop of 66 per cent. below normal.

### CABLES.

Apart from certain extra high-tension cables employed for connecting up transmission line terminal towers adjacent to the power-house, all the main cable work within the station was done by Callender's Cable and Construction Company, Ltd. The cables running to the transmission towers were supplied by British Insulated Cables, Ltd., and consist of S L type cables supported on the underside of the bridge described in the first article. All other outgoing cables are single-core paper-insulated lead-sheathed cables. In the

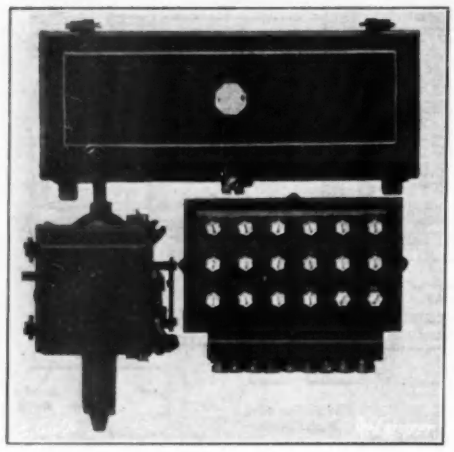


FIG. 38—LIGHTING FUSE AND SWITCH BOXES

turbine-room buildings, all high and low-tension three-core, paper-insulated, lead-covered cables are supported in racks, whilst all cables from the switchgear in the works sub-station to the turbine-room and boiler-house are run in Sykes conduits. The alternator cabling is arranged so that the Delta connections of the 9500-volt windings of the main step-up transformers are made at the alternator terminals, and the three current transformers for the alternator windings and the self-balanced transformers for the 9500-volt windings of the main step-up transformers are threaded over these connecting cables. The main and standby exciters are connected with their own field suppression pillars and terminal boards, and by changing over certain links the standby supply can be brought into service without interfering with the normal alternator protection.

In order to standardise cable racks and brass sealing ends, the number of cable sizes has been reduced to a minimum. For motors up to 25 horse-power three-core 0·0225 square inch cables are used, and for machines of higher capacity three-core 0·06 square inch cables. In the case of 3300-volt motors of 100 to 225 horse-power, three-core 0·03 square inch cables are employed, and for motors above 225 horse-power three-core 0·06 square inch cables. A chloride battery with a discharge capacity of 600 ampères for one hour and normally kept in a charged condition by a Westinghouse rectifier unit, serves for emergency lighting and for operating the switchgear and control circuits, although normally the two latter circuits are supplied by the 18 kW motor generator set made by the Metropolitan-Vickers Electrical Company.

### STATION LIGHTING.

From the works sub-station duplicate circuits are run to the main lighting switchboard, which was made by George Ellison, and from this board the supply is split into two independent lighting systems—the normal supply at 230 volts A.C., and the emergency system. Normally, the latter is also fed at 230 volts A.C., but in the event of failure of this supply automatic switchgear in the control room automatically changes over this supply to the battery, which always feeds the control room lighting circuits independently of the remainder of the station lighting system. All the lighting, heating and power sub-distribution boards were supplied by Donovan and Co. The boards, with capacities from 15 to 200 ampères, are of the makers' standard "Safuse" type, with floating contacts, large clearances, ample wiring space, front connections and adequate shielding. They range from two-wire lighting boards with the phase side fused, and the neutral provided with links, to three-phase, four-wire boards, with the phases fused and the neutral provided with solid connections. Many of the fuse boards are controlled by a switch immediately beneath and the lighting boards have watertight multiple switch boxes, as shown in Fig. 38. All the boards have special sealing boxes for the reception of paper-insulated, lead-covered cables, and the larger boards have Bakelite washers and unsplit compound chambers. The offices and other auxiliary buildings are electrically heated throughout by means of tubular heaters made by Barker, Young and Co., of Welwyn Garden City, and Credenda Conduits Co., Ltd., and all the heaters are controlled by thermostats. All the wiring for lighting and heating circuits is carried out with circular lead covered wire, and in the boiler-house the conductors have a bright wire armouring laid directly on the lead.

Among other details that have not previously been mentioned are all the materials for the railway sidings, supplied by R. White and Sons, of Widnes. About 3000 yards of standard gauge track was required, built from 80 lb. bull-head rails, besides flange rail track and several sets of points and crossings.

We are indebted to the Chief Engineer and Manager of the West Midlands Joint Electricity Authority—Mr. E. F. Hetherington, M.I.E.E., M.I. Mech. E., for permission to inspect the station and for providing us with illustrations and technical particulars of the civil engineering work and the station equipment. The whole of the designs and specifications were prepared by the authorities' own staff, under the supervision of Mr. Hetherington, with Mr. Ivan Daughtry, of Bedford, as advisory architect for the buildings and civil engineering work.

## An Engineer's Outlook.*

By Sir ALFRED EWING, K.C.B., F.R.S.

I AM old enough to remember a time when some of the spokesmen of science (never, indeed, the greatest) displayed a cocksureness that was curiously out of keeping with the spirit of to-day. Among contemporary leaders nothing is more general than the frank admission that they are groping in a half-light, tentatively grasping what at best are only half-truths. Things that to one generation seemed to be essential parts of a permanent structure are treated by the next as mere scaffolding. The quest of truth goes on endlessly, ardently, fruitfully. And yet with every gain of knowledge we realise more clearly that we can never really know. To understand, as Einstein lately said, is to draw one incomprehensible out of another incomprehensible. From time to time we discover a fresh relation between observed phenomena, but each of the things which are found to be related continues to evade our full comprehension; and that is apparently the only kind of discovery we can achieve. Our joy in the quest itself never fails; we are constantly learning that it is better to travel than to arrive.

The philosophical implications of this altered attitude are many—indeed, they concern the deepest springs of thought. What I wish at the moment to point out is that the new spirit strengthens a sense of brotherhood between the scientific adept and the average man, who in his own way is also commonly a seeker after truth. He listens gladly when the specialist drops his toga and admits that in scientific matters the only dogma is that there is no dogma. Obviously, too, the advance of science makes an increasing claim upon the layman's notice through its technical applications. It invades his home and alters his ways; it affects almost every feature of the daily round; it brings him interests, comforts, wealth; it enormously enlarges his powers of work and play. And, further, at a time like the present, when we carry a load of social and political and economic discontents, the ordinary citizen doubtless reflects that if only we could apply the dispassionate temper of science to the difficulties of the hour we might face them with less waste of effort and greater likelihood of settlement.

* * * *

The engineer finds himself obliged to admit that no mechanical model of the atom can be expected to give an adequate picture of that strange new world. Our mechanical ideas are derived from the study of gross matter, which is made up of vast aggregates of atoms, and any model must share the limitations this implies. It is futile to explain the constitution of the atom in terms applicable to gross matter, just as it would be futile to study the psychology of an individual by observing only the movements of crowds. So we must expect to find within the atom and among its parts qualities and actions different in kind from those we know, and paradoxes which without a wider vision we cannot interpret. Such a paradox, indeed, confronts us at the present time, when we try to harmonise the wave aspect and the particle aspect of the photon, of the electron, and, indeed, of matter itself. These things are still a mystery—a riddle which some day we may learn to read. Meanwhile, we do well to remember that any attempt to portray the structure of the atom in the language of ordinary experience is to give undue significance to symbols and analogies that are more or less invalid. Qualifying phrases like "so to speak" or "as it were" cannot be escaped. They are confessions that the image is inevitably a distortion of the reality it is intended to suggest.

* * * *

One may safely say that there is no department of scientific endeavour our meetings have not aided, no important step in the procession of discovery they have not chronicled. It was at our meeting of 1856 that Bessemer first announced his process of making a new material—what we now call mild steel—by blowing air through melted pig iron. Produced in that way, or by the later method of the regenerative furnace and the open hearth, it soon revolutionised the construction of railways, bridges, boilers, ships, and machinery of all sorts, and it now supplies the architect with skeletons which he clothes with brick and stone and concrete. It was at the Oxford meeting of 1894 that Lodge demonstrated a primitive form of wireless telegraph based on the experiments of Hertz, a precursor of the devices that were brought into use a little later through the practical skill and indefatigable enterprise of Marconi. At the same meeting there was an epoch-making announcement by the late Lord Rayleigh. His patient weighings of the residual gas which was found after depriving air of all its oxygen led him to the discovery of argon. That was a surprise of the first magnitude; it was the herald, one may say, of the new physics. Next year his colleague Ramsay presented other members of the family of inert gases. It is curious to recall the indifference and scepticism with which these really great discoveries were received. Some of the chemists of that day seem to have had no use for inert gases. But the stones which the builders were at first disposed to refuse are become head stones of the corner. In the architecture of the elements they fill places that are distinctive and all-important; they mark the systematic sequences of the periodic law. In a metaphor appropriate to atomic physics we may describe them as coy ladies with a particular symmetry in their crinoline of electrons, unresponsive to advances which other atoms are ready to make or to receive. Inert though they be, they have found industrial uses. Helium fills airships; argon fills incandescent lamps, and neon, so modest a constituent of the atmosphere that you might think it born to blush unseen, has lately taken to blushing deliberately and even ostentatiously in the shop-signs of every city street. In the field of pure science it was neon, outside the radioactive elements, that first introduced us to isotopes. And helium has a greater glory as the key to radioactive transformations and historian of the rocks. Disciples of evolution should be grateful to helium for delivering them from the cramping limits of geological time which an earlier physics had mistakenly imposed.

My own recollection covers many surprises that are become commonplaces to-day—the dynamo, the electric motor, the transformer, the rectifier, the storage battery, the incandescent lamp, the phonograph, the telephone, the internal combustion engine, aircraft, the steam turbine, the special steels and alloys which metallurgists invent for every particular need, wireless telegraphy, the thermionic valve as receiver, as amplifier, as generator of electric waves. To that last we owe the miracle of broadcasting. Who, a generation ago, would have imagined that a few yards of stretched wire outside the window and a magic box upon the sill should conjure from adjacent space the strains of Beethoven or Bach, the exhortations of many platforms, the pessimism natural to those who forecast the weather, and the optimism of orators who have newly dined?

> "Sounds and sweet airs, that give delight and hurt not.
> Sometimes a thousand twangling instruments. . . .
> And sometime voices . . . that, when I waked,
> I cried to dream again."

I don't know any product of engineering more efficient than that magic box. It needs no attention; it is always ready for service; and when you tire of it you have only to switch it off. A blessing on it for that! Heard melodies may be sweet, but those unheard are often sweeter. Do you ever reflect, when you pick and choose among the multitude of airs and voices, or shut out all from your solitude of thought, that they are still there, physically present, individual, distinct, crowding yet not interfering, besetting you though you do not perceive them, silent until you determine that one or another shall catch your ear? Go where you will, to the ocean or the wilderness or the Pole, you cannot escape that vast company of attendants; they come to you unheard, unseen, from every quarter of the globe with a swiftness no other messengers approach. Is any fairy tale so strange as that reality? In all the wizardry of science surely there is nothing more wonderful than this.

* * * *

Among the inventions which have revolutionised the habits of modern man some were developed by steps that were mainly empirical. Others, especially those that are most recent, have had a very different history; science has been their incubator and their forcing-house. In the advance of any invention there is bound to be an element of trial and error, but when the scientific method is consistently applied the pro-

* Excerpts from the Presidential Address, British Association for the Advancement of Science, York, 1932.

portion of error is small and progress is swift. We see this exemplified in the development of mechanical flight, where one difficulty after another has been vanquished by aid of well-directed theory and well-related experiment. Or consider that immensely important modern art, the art of communication by telegraph and telephone, by wire and "wireless." There the efforts of scientific engineers were dominant at every stage, and it was through their guidance that the art quickly achieved its world-wide triumphs.

* * * *

In the present-day thinkers' attitude towards what is called mechanical progress we are conscious of a changed spirit. Admiration is tempered by criticism; complacency has given way to doubt; doubt is passing into alarm. There is a sense of perplexity and frustration, as in one who has gone a long way and finds he has taken the wrong turning. To go back is impossible; how shall he proceed? Where will he find himself if he follows this path or that? An old exponent of applied mechanics may be forgiven if he expresses something of the disillusion with which, now standing aside, he watches the sweeping pageant of discovery and invention in which he used to take unbounded delight. It is impossible not to ask, Whither does this tremendous procession tend? What, after all, is its goal? What its probable influence upon the future of the human race?

The pageant itself is a modern affair. A century ago it had barely taken form and had acquired none of the momentum which rather awes us to-day. The Industrial Revolution, as everybody knows, was of British origin; for a time our island remained the factory of the world. But soon, as was inevitable, the change of habit spread, and now every country, even China, is become more or less mechanised. The cornucopia of the engineer has been shaken over all the earth, scattering everywhere an endowment of previously unpossessed and unimagined capacities and powers. Beyond question many of these gifts are benefits to man, making life fuller, wider, healthier, richer in comforts and interests and in such happiness as material things can promote. But we are acutely aware that the engineer's gifts have been and may be grievously abused. In some there is potential tragedy as well as present burden. Man was ethically unprepared for so great a bounty. In the slow evolution of morals he is still unfit for the tremendous responsibility it entails. The command of Nature has been put into his hands before he knows how to command himself.

I need not dwell on consequent dangers which now press themselves insistently on our attention. We are learning that in the affairs of nations, as of individuals, there must, for the sake of amity, be some sacrifice of freedom. Accepted predilections as to national sovereignty have to be abandoned if the world is to keep the peace and allow civilisation to survive. Geologists tell us that in the story of evolution they can trace the records of extinct species which perished through the very amplitude and efficiency of their personal apparatus for attack and defence. This carries a lesson for consideration at Geneva. But there is another aspect of the mechanisation of life which is perhaps less familiar, on which I venture in conclusion a very few words.

More and more does mechanical production take the place of human effort, not only in manufactures, but in all our tasks, even the primitive task of tilling the ground. So man finds this, that while he is enriched with a multitude of possessions and possibilities beyond his dreams, he is in great measure deprived of one inestimable blessing, the necessity of toil. We invent the machinery of mass production, and for the sake of cheapening the unit we develop output on a gigantic scale. Almost automatically the machine delivers a stream of articles in the creation of which the workman has had little part. He has lost the joy of craftsmanship, the old satisfaction in something accomplished through the conscientious exercise of care and skill. In many cases unemployment is thrust upon him, an unemployment that is more saddening than any drudgery. And the world finds itself glutted with competitive commodities, produced in a quantity too great to be absorbed, though every nation strives to secure at least a home market by erecting tariff walls.

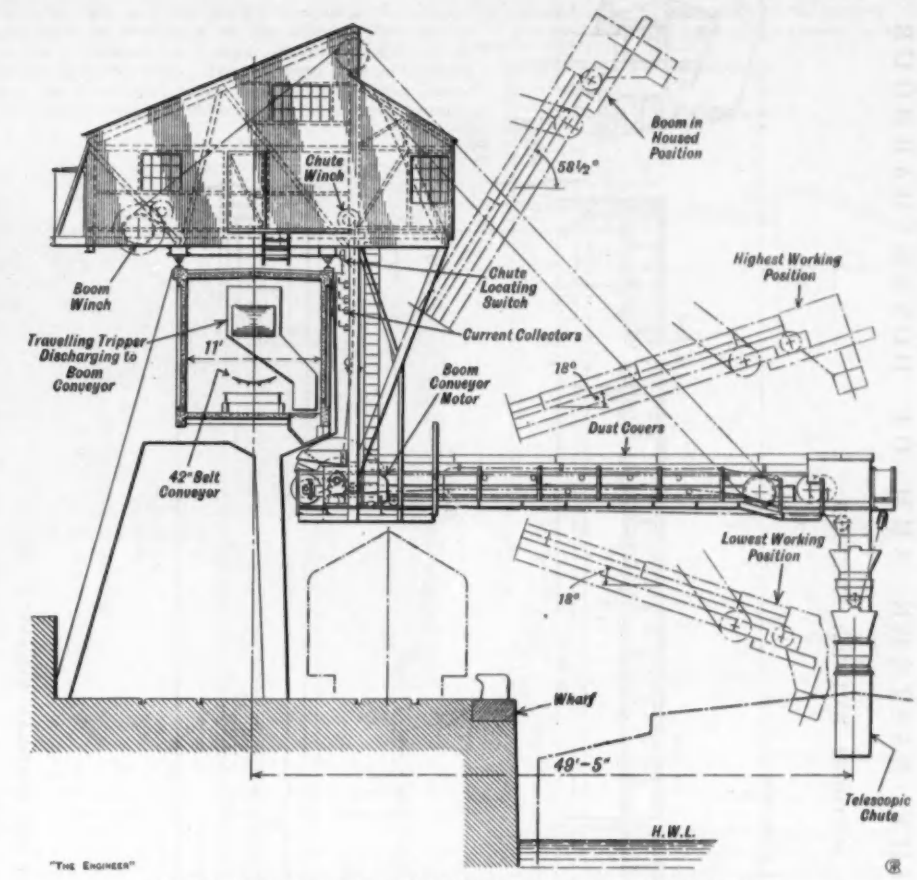
We must admit that there is a sinister side even to the peaceful activities of those who, in good faith and with the best intentions, make it their business to adapt the resources of Nature to the use and convenience of man.

Where shall we look for a remedy? I cannot tell. Some may envisage a distant Utopia in which there will be perfect adjustment of labour and the fruits of labour, a fair spreading of employment and of wages and of all the commodities that machines produce. Even so, the question will remain, How is man to spend the leisure he has won by handing over nearly all his burden to an untiring mechanical slave? Dare he hope for such spiritual betterment as will qualify him to use it well? God grant he may strive for that and attain it. It is only by seeking he will find. I cannot think that man is destined to atrophy and cease through cultivating what after all is one of his most God-like faculties, the creative ingenuity of the engineer.

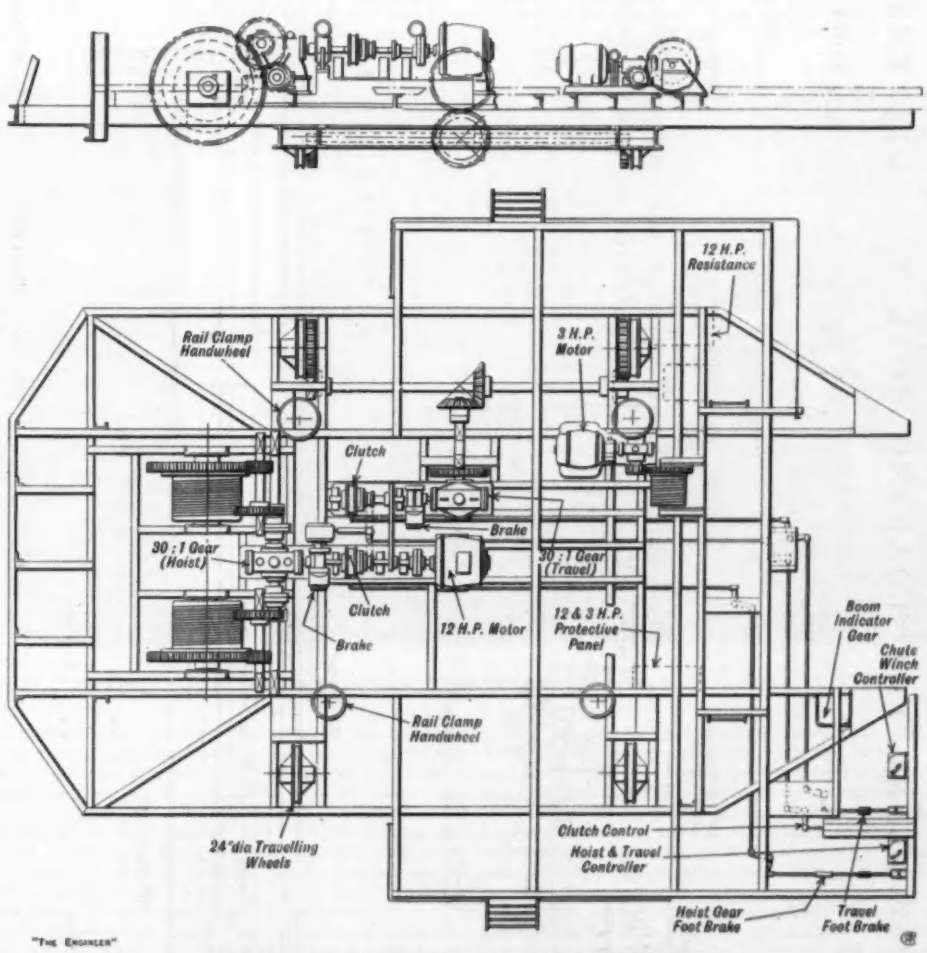
## Ship Coaling Plant at Dover.

ON the occasion of a recent visit to Dover, we saw the steam collier "Tiridail" come alongside the Eastern Arm at 12.55 p.m. and start to tie up. She was steaming out of harbour again at 4.30 p.m. and had, in the interval, taken on board 824 tons of coal. The actual time of loading was, however, only 1 h. 55 min., as there were several mishaps through faulty bottoms of the wagons bringing the coal alongside and delays through the non-arrival of trucks. This performance was effected by the new belt conveyor loading plant supplied to the Southern Railway by the Fraser and Chalmers Engineering Works, of Erith. We give some illustrations of the plant herewith and on page 234.

The new plant, it will be seen, runs parallel with the ropeway—from the Tilmanstone Colliery, some 8 miles away, to the end of the Eastern Arm—and might be said to be a justification of the railway company's opposition to the ropeway. It is capable of loading into ships alongside run-of-the-mine coal at the rate of 500 tons an hour.




CROSS SECTION OF WHARF CONVEYOR AND LOADING MACHINE

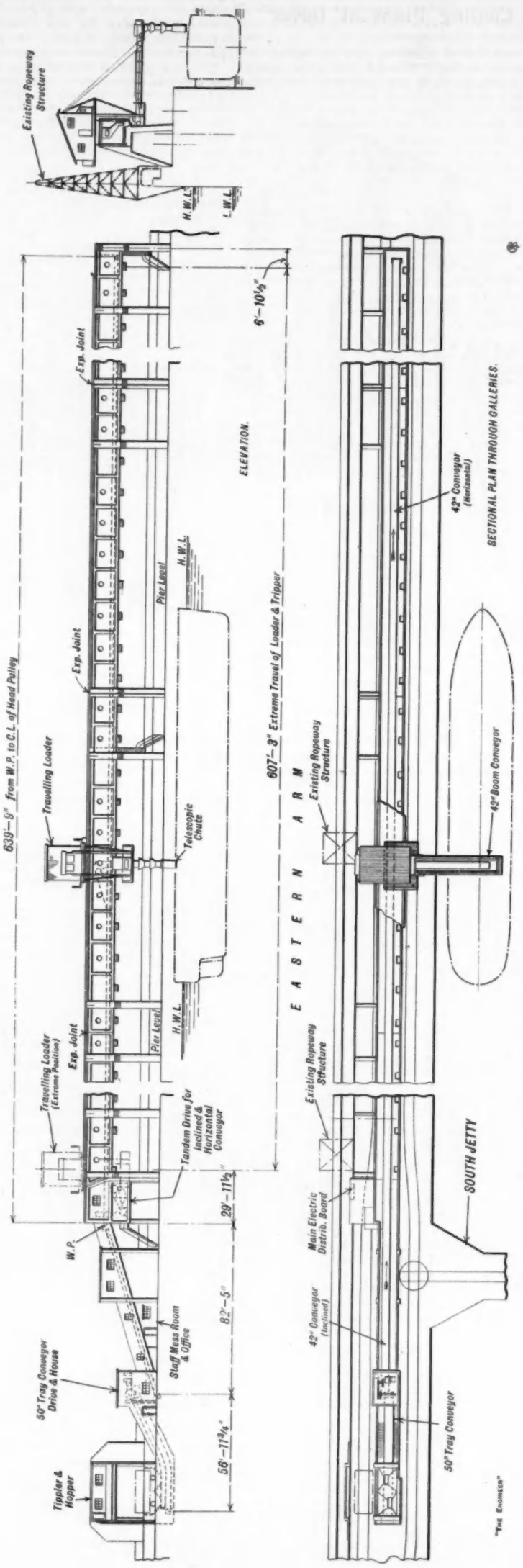



PLAN OF MACHINERY ON LOADING MACHINE FLOOR

The essential features of the plant are:—A tippler

# PLANT FOR LOADING COAL TO COLLIERS ON THE EASTERN ARM OF DOVER HARBOUR

MR. G. ELLSON, M. INST. C.E., CHIEF ENGINEER, SOUTHERN RAILWAY, ENGINEER




GENERAL ARRANGEMENT OF COAL HANDLING PLANT OF THE SOUTHERN RAILWAY AT DOVER

for tipping the coal out of the railway trucks into a hopper; a tray conveyor for elevating the coal; a belt conveyor running along the length of the quay, and a transverse conveyor on a derricking boom, with a telescopic shoot, for loading the coal into the ships' holds. The whole plant has been carefully laid out with the double object of preventing a nuisance from coal dust flying about, and of preventing the coal and machinery being affected by sea water in rough weather.

## THE TIPPLER.

Taking the constituent items in rotation, the tippler, of which we give a line drawing, is of the Fraser and Chalmers, Marshall type, and is housed in the building on the extreme left of the panoramic view, p. 234. It is capable of dealing with 10 and 20-ton trucks at the rate of forty-eight per hour, so that it can easily handle 500 tons of coal an hour. The tippler consists of the usual platform, on to which the truck is run with the help of a Royce electric capstan. This platform, when at rest, sits on a solid foundation, so that through traffic does not subject the tippler to any stresses. The platform is also carried by two curved girders, one at either end, which are pivoted to the frame at A. The connection between the platform and the curved girders is effected by the pivot F, which is slightly off centre. Two wire ropes are passed under the girders and go to a winch in the overhead machine room.

In the process of tipping the ropes are hauled in and the platform rocked about the pivot F until the side of the truck comes against the bolster B. Then the truck, platform and girders form a solid unit, which rotates about the pivot A until the top of the truck meets the bolster C. The truck is then clamped between the platform and the two bolsters, so that further rotation about A is prevented. The whole frame then starts rolling on the sector-shaped arms D and the track E, until the truck is almost upside down and its contents are discharged into the hopper below. It will be noticed that during the operation the truck is raised appreciably, with the result that the hopper can be built above ground and excavation minimised. In fact, the bottom of the hopper is scarcely 3ft. below ground level, although it will hold two truck loads of coal, and the chamber beneath, which accommodates the tray conveyor, is only 8ft. 6in. deep. It is noteworthy that should the attendant inadvertently tip a truck when the hopper is full nothing untoward happens, as the coal simply stays in the truck until the conveyor has removed the surplus.

The bearings of the pivots A are mounted on pads in such a manner that as the truck is relieved of its load, the axle springs of the truck are free to expand without straining the truck body.

There are, of course, limits to the size of the truck which this tippler will accommodate, and one of them is the height, which must not be less than 7ft. 3in., as otherwise the truck would fall on to the top bolster, instead of being caught quietly by it. We noticed that it is necessary to use only the ordinary hand brake to locate the truck on the platform, and that no chocks were used.

There is a 45 horse-power electric motor, running at 720 revolutions per minute, to operate the tipping hoist, and it is geared to the two drums through worm gearing. The motor is arranged between the two drums and at right angles to their axis, so that a very simple and accessible lay-out is provided. In fact, we noticed that accessibility has been given consideration throughout the whole plant and yet the buildings are not bulky.

The operation of the tippler is controlled by three push-buttons—one for tipping, one for lowering, and one for "stop," so that the attendant has little to think about in operating the machine. He pushes the first button on the arrival of a loaded truck and everything happens automatically until the truck is tipped. When he judges that all the coal has run out he pushes the second button and the truck returns to the track. The third button is provided for cases of emergency.

This cycle is provided for by a series of double-pole contactors mechanically and electrically interlocked so that only one direction of operation can be in service at one time. The contactors work in conjunction with an automatic starting rheostat, incorporating an eddy current retarder which ensures correct increments of speed in each direction. A time-lag overload relay is provided in each line. The buttons for operating this gear are arranged, outdoors, just at the entrance to the tippler, but are of the weatherproof type. They are associated with a loud-speaker telephone, connected with the loading machine, so that the tippler man can be notified as to the requirements of the ship being loaded—it should be remembered that there is no appreciable storage capacity in this plant and that truckloads of coal must be shipped as they are tipped. In fact, the trucks provide the storage. Telephonic communication is maintained between the two vital parts of the plant through bare wires stretched on the overhead gantry and rubbing contacts on the loader.

## THE CONVEYOR.

The hopper into which the coal is tipped is of reinforced concrete and has two bottom outlets, each

of which is independently controllable by means of rack and pinion gates. Beneath these outlets there is the tray elevator-conveyor mentioned as the second item of the plant. Its business is to raise the coal to such a height as to command the main wharf conveyor. The tray conveyor is 57ft. long between centres and rises 14ft. in that distance. Its width is 50in. and it is of standard construction with overlapping steel trays having riffles to prevent the coal running back down the incline. The trays are carried by two roller chains, running on side rails. The chain rollers are of cast iron and run on hardened steel bushes to which are fixed the inside chain links. These links are mounted on through axles, to which are fixed the outer chain links. This arrangement allows for the angular movement over the end tumblers, which is quite slow. Skirt plates are fixed on either side of the conveyor to concentrate the coal on the centre, and the head is well boxed in. Incidentally, the two outlets of the hopper are offset from the centre of the conveyor, so that each one tends to feed opposite sides of the trays and thus spread the load. The conveyor works in a concrete tunnel and is driven by a 20 horse-power totally enclosed shunt motor running at 720 r.p.m. The controls for this motor are interconnected with those of the main conveyor and the boom conveyor, so that they can only be started up in the proper sequence—that is to say, the main conveyor cannot be started until the boom conveyor is ready to take away its deliveries to the ship, and the tray conveyor from the tipper cannot be started until the main conveyor is under way. It is obvious that such a precaution is necessary when it is recalled that coal would pile up at either of the interconnections at the rate of 500 tons an hour if the conveyors were started out of their correct sequence.

The coal flows down the chute from the tray conveyor on to the main conveyor, which is of the Robins belt type. It rises from about ground level to a height of 26ft., in a distance of about 82ft., and then continues horizontally for some 640ft. inside the overhead passageway which makes such a prominent feature in our engraving on page 234. The actual distance between the centres of the pulleys of this conveyor is 737ft., and it is 42in. wide. It runs at 375ft. per minute, and is capable of handling 500 tons per hour of coal having a weight of 50 lb. per cubic foot and of any size up to 12in. cube. The driving motor is of 60 horse-power, and is arranged, as will be seen from the general arrangement, on the return side just about the top of the incline. The belt itself is of five-ply 28 oz. duck at the centre, reinforced to seven-ply at the edges. The centre part is protected by a layer of rubber $\frac{1}{16}$in. thick on the carrying side. The carrying side of the belt runs on five-shaft roller bearing troughing idlers spaced at 4ft. centres, while the idlers on the return side are spaced at 9ft. The return side is protected by a decking of $\frac{1}{8}$in. mild steel plate, but it seemed to us that it was hardly necessary, as there was no spilage from the carrying side above..

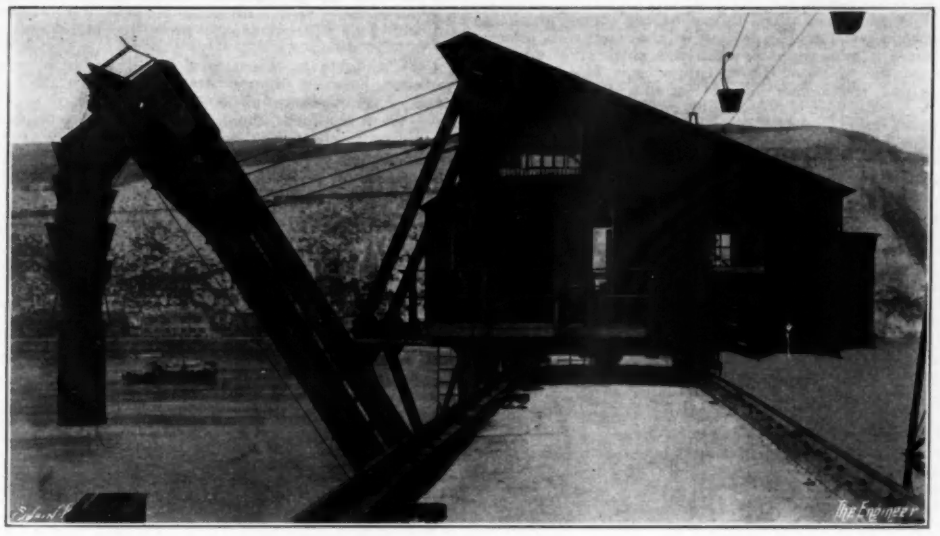
There is also another assurance against dust nuisance in the form of a steel plate tunnel through which the first 50ft., or so, of the conveyor passes. In this tunnel there is an opportunity for the dusty coal to precipitate into the general mass after it has been stirred up by the tippling and the outlet from the tunnel is masked by a simple apron of sacking.

The coal is taken off the conveyor by a tripper of the type in which the belt is folded back on itself over two pulleys, virtually an end pulley over which the coal is discharged into a shoot, yet the belt goes on to the far end after passing over the second pulley. These pulleys are mounted on a carriage which straddles the belt and runs on rails on either side to enable tipping to be effected at any place along the length of the conveyor. The tripper is propelled by the belt itself, by gearing one of the pulleys to the carrying wheels, through worm gearing and a double mitre set for reversing. There is, of course, a clutch to put this gear in and out of action.

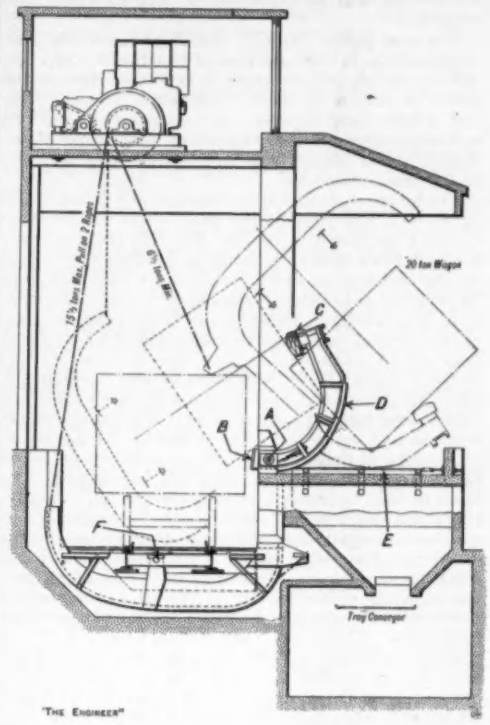
At intervals of about 15ft. there are openings in the floor of the conveyor gallery for the discharge of the coal—they are situated directly below the portholes in the wall, shown in the panoramic view. These openings have shutters and communicate with the loading machine, which we are about to describe. When it is desired to move the tripper from one opening to another, for the purpose of trimming the ship, the supply of coal to the conveyor is stopped at the truck tippler and the belt is run until it is empty. Then the travelling gear is clutched in and the belt used to move the tripper to the next opening. It is, of course, only occasionally necessary to perform this manœuvre, so there is no need for an attendant to be constantly at the tripper.

The loader, of which we give a general arrangement drawing, p. 229, and some views on p. 234, runs on rails on the top of the conveyor gallery. The centres of this track are 12ft. apart. As will be seen from the drawing, the loader comprises two quite distinct parts—the machinery cabin above and the loading boom below the conveyor gallery, the two being connected together by a strut depending vertically from the main frame of the cabin. The overhanging weight of the boom is counterbalanced by 19 tons of ballast in the rear of the cabin, and the whole machine weighs 60 tons. The result is that the centre of gravity never moves more than 1ft. 7in. from the centre of the track with the boom in the extreme positions. Rail grips are, however, provided, and the plant has been designed to withstand a wind pressure of 30 lb. per square foot on account of its exposed situation. In this connection it is noteworthy that the movements of the loader are effected through gearing that gives comparatively slow speeds, so that the operator has a decisive control and cannot be over-ridden by a sudden gust of wind forcing the boom beyond his estimation. Those who have experience of seaside operations will appreciate this restriction.

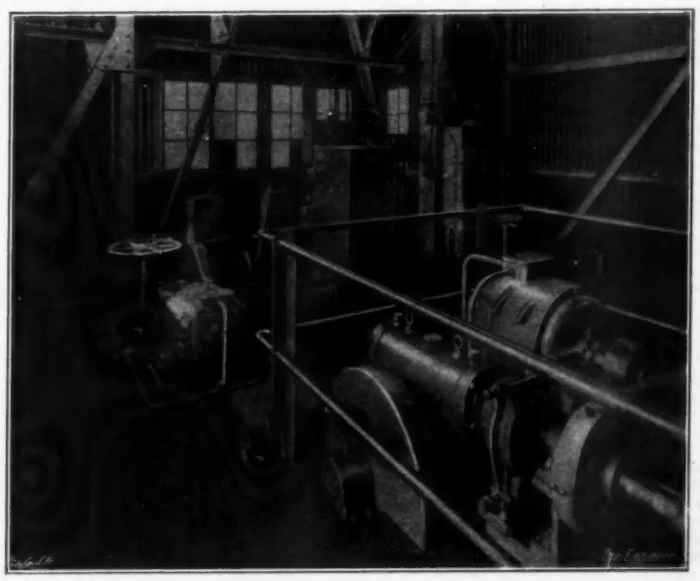
The cabin of the loader contains all the control apparatus and the winches which are used for manipulating the loading boom. It is obvious that arrange-

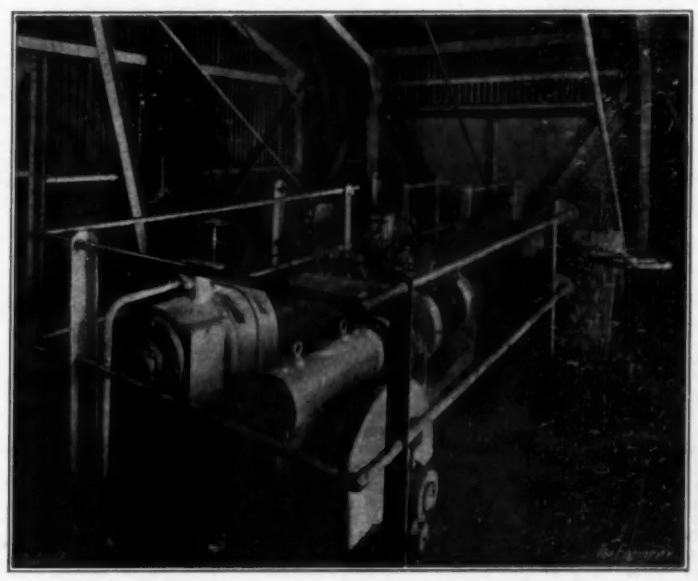


THE LOADING MACHINE FROM THE TOP DECK




TIPPLER





THE MACHINERY CABIN OF THE LOADER: ON THE LEFT A VIEW TOWARDS THE CONTROLS

ments must be made to ensure that the reception end of the loader is beneath one of the shoots in the floor of the conveyor gallery when it is put to work. This adjustment is facilitated by a series of bow-shaped electric contact wires on the structure, each of which represents a shoot. As the loader is moved from place to place contact is made with these wires and a lamp is lit in the control cabin. With this lamp alight the attendant can be assured that the boot of the loader is underneath one of the shoots through which coal will be delivered by the conveyor and tripper.

The coal passes through the shoot from the main conveyor on to the tail end of the boom conveyor, and is carried out by another belt, also 42in. wide, which is driven by a 15 horse-power motor. This belt is 41ft. long between the centres of the pulleys, and is totally enclosed to prevent dust being blown about by the wind. It is of the same general style as the main conveyor.

The boom is pivoted at its base and can be derricked up to clear the rigging of a ship while the loader is moved from hatch to hatch. For this purpose there is a 12 H.P. motor working a double-drum winch in the machinery cabin, and this motor can also be clutched in to travel the loader from place to place.

In the working position the boom has a range of from 18 deg. above to 18 deg. below the horizontal position to accommodate the rise and fall of the vessel being loaded; but there is also a telescopic shoot at the end of the boom to let the coal down gently into the hold of the ship. This shoot starts immediately below the delivery end of the conveyor, as a series of three cones, each of which is attached to its lower member by a set of gimball joints, so that it can be moved in any direction. Finally, there is a plain spout made of three sections which can be telescoped, one inside the other, to reach right down into the ship's hold. These telescoping parts are held by a wire rope which goes to a small electric winch in the control cabin, so that the operator can draw up the shoot as the coal piles up in the ship's hold.

*Apropos* these controls we were rather intrigued with the system of indication in the cabin. It is obvious that there must be positions of the boom when, and when not, it is permissible to load coal. So an indicator has been arranged to show the angle at which the boom is lying, but the erector had gone beyond this and painted the length of the indicator with red for danger, green for permissible working, and white for the normal range of loading.

In reviewing this one loading job of the plant at Dover, it struck us that the ship's crew and the stevedores might have made much more use of the appliances offered for their service, but, in any case, the performance is meritorious.

We have to thank Mr. G. Ellson, the chief engineer of the Southern Railway Company, for the facilities which he has offered to us in collecting the data for this article, and to his staff for their courtesy during our visit.

## Springs for Rolling Stock.

WE give below some extracts from a booklet which we have just received from the Coil Spring Makers' Association, Church-street, Sheffield, entitled "Steel Springs or Rubber Springs," recording the researches by a Committee of the leading manufacturers of coil springs into the comparative advantages of the two types of springs.

The life of railway stock depends largely on the efficiency of the buffing and draw-bar gear. The leading British coil spring manufacturers decided, for their own satisfaction, to carry out a careful and thorough investigation into the relative value of steel springs and rubber springs used by railway engineers for railway stock. Whilst steel and rubber springs each have their own sphere, there are some applications, such as for buffing and draw-gear, for which either may be adopted.

The function of the buffing or draw spring is to prevent or reduce shock, and it does this by lengthening the time and distance through which the blow operates, thus reducing its average force. The simplest way to consider the forces involved in buffing action is by use of the "Law of Conservation of Energy." Take the simplest case of a moving wagon meeting an unbraked stationary one. Knowing the speed and weight of the moving wagon, its kinetic energy can easily be calculated. It is impossible to destroy any of this energy, and after impact it is divided into three parts:

(*a*) That which remains in the wagons if they continue to move forward; this can readily be calculated.
(*b*) That which is taken up by the buffing springs; this can be calculated from test results of the springs.
(*c*) The balance which is expended in shock, tending to damage the wagons and contents, which can be arrived at by subtracting (*a*) and (*b*) from the original energy of the moving wagon.

(*a*) cannot be controlled and, to make (*c*) a minimum, the energy taken up by the springs (*b*) must be a maximum. This is a fundamental point. Its application involves no difficult measurements or calculations and it gives straight away an accurate measure of the efficiency of a buffing spring. It follows, therefore, that the first two fundamental principles of buffer design are:

(*a*) That the stroke should be a maximum.
(*b*) That the spring should take up the maximum amount of energy.

For a cylindrical helical spring the load is proportional to the deflection.

The energy absorbed in compression can be divided into two parts:

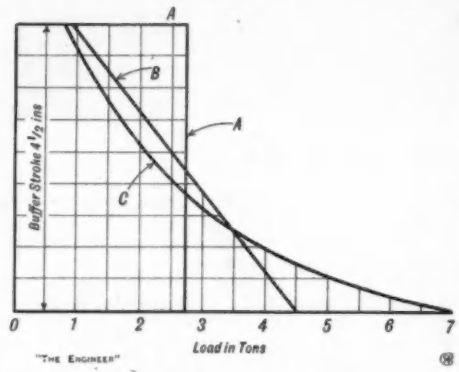
(*a*) That which is given up by the spring on the return stroke and
(*b*) that which is dissipated by friction, &c., in the spring.

The dissipated energy is usually a very small amount. In the case of volute springs the larger diameter coils compress first and, consequently, the deflection per ton decreases as the load increases. In addition, there is a certain amount of friction between the coils and, consequently, the energy absorbed is not all returned on the return stroke.

In the case of an india rubber spring, as the rubber compresses its area increases and, consequently, here again the deflection per ton decreases with increase of load. The energy returned is decidedly less than that put in on compression.

It is sometimes urged that a buffing spring which can absorb a considerable portion of the energy in internal friction, is more valuable than one which gives up again almost the whole of the energy input. This, indeed, is true and the rubber spring has this desirable quality. Unfortunately, it is not possible for the rubber spring to convert this absorbed energy into heat without itself suffering in the process. If a rubber spring is repeatedly loaded and unloaded through any appreciable range, heating and deterioration occur, even if the loading is as slow as six strokes per minute, and some loss of elasticity soon becomes apparent. In other words, the life of the rubber spring is likely to be inversely proportional to its property of dissipating energy internally.

Shock is proportional to the acceleration (positive or negative) and to the force producing it. A given amount of energy has to be taken up during a certain distance, and the shock and retardation and the acting force will all have a minimum value when the force exerted by the buffer is constant for the whole of the stroke. This condition cannot be met by any ordinary spring, either steel




BUFFER SPRINGS—LOAD AND DEFLECTION

or rubber, although it can be met by a hydraulic gear, or a combination of springs and a system of variable fulcrum levers, neither of which is of any use for vehicles.

The diagram illustrates this simple case; the examples taken are standard English wagon buffing springs. For comparison, the areas enclosed have all been made the same to represent the given amount of energy, viz., 12·1 inch-tons, the ultimate load of the rubber spring being reduced from about 8 tons to 7 tons to correspond; the diagram fairly represents the actual case. If the resistance of the buffer could be made the same throughout the stroke, this need be no more than 2·7 tons, and this is a direct measure of the shock to the wagon. With the steel spring, this figure goes up to 4·5 tons, while with the rubber, the shock has gone up to 7 tons.

For speeds greater than those sufficient to bring the buffers just home, the excess energy which the buffers cannot take up will be the measure of the shock. It will thus be seen that for the heavier impacts (which constitute by far the largest number) the curved load deflection characteristic makes no difference at all, the value of the spring being simply measured by its capacity to take up energy.

For a much lower number of impacts, where the buffer is compressed more than, say, 65 per cent. of its stroke up to just its full stroke, an inspection of the diagram will show that the curve deflection characteristic (curve C) comes to the right of the straight line B and indicates a greater shock; this is a disadvantage. For the remainder of the impacts, where the speed is so low that the buffer is not compressed as much as 65 per cent. of its stroke, the curve C coming to the left indicates a less shock.

The last two cases are the least important of the impacts because the shock will in any case only be small.

The one initial property that is important is, therefore, that of storing energy. This is what is paid for, and the amount of energy a spring can store is a direct measure of its value, subject only to its ability to retain this quality, which will be considered later.

The only way in which the steel and rubber spring can be usefully compared is to take a number of actual examples of each and compare the energy stored. This comparison can be made either on the basis of space occupied, of total weight of spring (including, of course, in the case of the rubber spring, the intermediate steel washer plates), or of price. Comparison shows that whereas a short recoil spring composed entirely of active rubber with no steel supporting ring or steel intermediate washers, stores 1 inch-ton of energy for every 24·07 cubic inches of bulk, a similar steel spring requires 38·4 cubic inches, *i.e.*, 60 per cent. more space, and weighs six times as much as rubber.

For this particular purpose, where the length of the spring is much less than its diameter, there is not the least doubt that the rubber spring is superior to the steel. The reason is obvious, as the rubber spring is composed entirely of active material, while the steel spring has an unusually large proportion of end coil which is not active, and which costs more than the active coils due to the extra operations of tapering, smithing and grinding. In this particular case the rubber spring is at its maximum efficiency and the steel helical spring at its minimum, and as the length and stroke of the springs increase, the position reverses.

Taking well-designed rubber springs of greater length, the average space required per inch-ton of capacity is 38·8 cubic inches. The average space required by a steel spring for the same purpose is 27·6 cubic inches per inch-ton capacity, which is 40 per cent. less than required by the rubber spring. In other words, if the maximum capacity is required from a given space in, say, a buffer, the steel helical spring can do 40 per cent. better than the rubber spring.

The comparison between steel and rubber on the basis of weight shows in favour of rubber, which requires about 2·9 lb. per inch-ton of capacity, as against 4·2 lb. for the steel coil spring; in other words, the steel spring for a given capacity weighs about 45 per cent. more than the rubber. This will not usually prove too big a handicap for railway work.

Cost is liable to fluctuation, and there is a greater variation between different items than with the other bases of comparison; although a number of particulars have been obtained, these cannot be given in detail. Excluding recoil springs, rubber springs cost an average of 28d. per inch-ton of capacity, and steel an average of 15d. per inch-ton. The opening words of this paragraph must be kept in mind in considering these figures.

*Summary.*—This completes the first portion of the investigation and the conclusions may be summarised as follows:—

A. The most important quality of a spring is its capacity to store energy.
B. The working stroke should be as long as possible to prevent shock.
C. Internal friction is an advantage, provided that it is certain that the spring can convert mechanical energy into heat without detriment to itself.
D. There is a considerable difference between the various makes of rubber springs, both in capacity and price, although they are made to the same specification.
E. The quality of a spring to give a resistance that increases more rapidly than the deflection, does not make the spring more effective in preventing shock. Generally, it makes no difference at all, but is sometimes a disadvantage.
F. In a given cylindrical space, where the length is not less than 1½ times the diameter, a steel spring can have about 40 per cent. more capacity than a rubber spring.
G. For a given capacity, a steel spring weighs about 45 per cent. more than a rubber spring and costs only about half as much.
H. For very short springs, where the length is much less than the diameter, the rubber spring is the better on all three counts.

*Springs in Service.*—Having now investigated the initial properties of the two kinds of springs, it remains to find out how these properties are retained in service.

Ever since steel has been used for springs it has been rightly regarded as the most durable material, without exception, for this purpose. With steel springs there are two causes of deterioration, rust and fatigue. The life of helical springs, if given very moderate attention, is generally not seriously affected by rust. Fatigue is entirely a matter of design; if the working stress is below the fatigue limit the life of the spring will exceed that of the vehicle. On the other hand, it is well known that rubber is subject to certain changes with the lapse of time, which result in hardening and loss of elasticity. In spite of the very considerable progress that has been made in the manufacture of rubber springs, it seems to be considered quite usual for a rubber spring to lose 2 per cent. of its length within the first two years. This is not sufficient to make the plunger loose, as the initial compression is usually about 10 to 12 per cent., so this loss is not sufficient to cause any trouble to the maintenance staff as regards the springs. Two per cent. seems at first sight quite small, and it is easy to overlook that this means a very much greater proportionate loss of capacity.

It will generally be found that the percentage loss of capacity is between four and eight times the percentage loss of height. It is capacity that is really bought, and this loss means that this amount of extra punishment comes, in consequence, on to the wagon structure. No doubt the extent of this loss will come as a surprise to most railway men.

As a second method of investigation, springs were taken for test from the first wagons available, there being no other selection than choosing the oldest wagons. In the case of the steel springs, the date was stamped on the springs, which, in all cases, corresponded nearly with the age of the wagon, but no dates were marked on the rubber springs. The length of service of the rubber springs is, therefore, not definitely known, but it is assumed to be the age of the wagon in each case. There were several different makes of steel springs; all the rubber springs were of one make.

From this examination it was found that the loss in capacity of the rubber spring was six times as great as that of the steel spring over the seven-years' period, and amounted to nearly a quarter the original.

Special laboratory fatigue tests have the advantage that the conditions of test are definite and can be reproduced, but while they give satisfactory results with steel springs, they cannot be made to produce strictly the effect of length of service on rubber springs. No account is taken of the change in the rubber which occurs with lapse of time; this favours the rubber spring. On the other hand, the compressions must succeed each other at much shorter intervals than would occur in actual service, and this handicaps the rubber spring, which heats up to a much greater extent than the steel spring. It can be stated that all such tests of which records are available, confirm the deduction made in the first part of the report, that where it is desired to get the maximum spring capacity in a cylindrical space where length is not less than 1½ times the diameter, the steel spring can be relied on to give better results than rubber.

## Railway and Road Matters.

THE troubles of the Irish railways in not being able to increase their rates to suit the higher cost of transportation; in contending with a road competition that is more severe than in England; and in having to pay wages that are 140 per cent. higher than pre-war, have been added to by their having either to use unsuitable foreign coal for the locomotives, or pay a tax on the coal imported, as hitherto, from England.

THE pooling scheme of the L.M. and S. and L. and N.E. Railways came into operation on September 1st, and the travelling public will at once perceive its benefits. Not only will those be seen in the long journeys between London and Scotland and London and Nottingham, Leeds and Bradford, but in such local journeys as Liverpool and Manchester by three routes and between Leeds and Bradford, Nottingham and Derby, Nottingham and Leicester, &c.

THE contact method of operating street signals, mentioned herein on March 25th, as having been installed at the junction of Cornhill, Gracechurch-street, and Leadenhall-street, has been put into service at the crossing of two roads in Pendleton, Manchester. We refer to this installation, even although there are several others now in the country, because the arrangements include the movements of tramcars. The latter operate through a circuit on the overhead wire.

THE practice of propelling an omnibus by means of the starting and lighting battery is not one which is to be recommended, but drastic measures are sometimes necessary in cases of emergency. Recently a breakdown occurred on an omnibus fitted with a two years' old Kathanode battery, and by engaging first gear and making use of the starter the omnibus was propelled about three-quarters of a mile to a point where attention could be given. The battery was not hurt and the lighting of the omnibus was not interfered with.

AN addition will be made to the fleet of L.M.S. named expresses on and from Monday, September 12th, when the 5.40 p.m. express from Manchester (London-road) to Euston and the corresponding 11.50 a.m. express from Euston to Manchester will be known as "The Comet." There are now seventeen expresses on the L.M.S. bearing distinctive names, which are displayed on boards on the coaches. One of these trains, "The Irish Mail," is the oldest named train in the world, having borne this title for eighty-three years.

THERE are four lines of way between Campbell-road Junction and Barking, on the Tilbury section of the London, Midland and Scottish Railway, of which two have, for many years, been equipped for electric traction and, later, furnished with automatic signalling. By those lines the District Railway trains reach Barking. On September 12th the two lines will be extended to Upminster and electrically operated trains, protected by automatic signals, will run to and from that point. The widening works, new and altered stations, &c., were noted in our annual article "Railway Engineering in 1931," in our issue of January 22nd last.

AN accelerated service which ensures next morning delivery of goods between practically all stations has just been introduced by the Southern Railway. A marked improvement in the goods services has been brought about by a considerable speeding up of various important goods trains, which has been made possible by the introduction of a large number of vacuum brake fitted vehicles which enable these goods trains to be worked in the same way as passenger services. There are now upwards of 600 covered vans of this type in use on the Southern Railway and further vans are in course of construction. Some of the main line trunk services have been speeded up by over an hour.

A FATAL accident occurred on August 23rd on the Great Orme Tramway, Llandudno. The line is worked on the inclined plane principle by a winding engine operating a wire rope coupled to a draw-bar on the tramcar which ran on two four-wheeled bogies. At the steepest point on the line, where the gradient is 1 in 4, the draw-bar broke and the car ran away. After running 169ft. it left the rails and, 75ft. further on, ran into a wall. The driver had an employee's child with him and both were killed. The draw-bar had only been in use for a week. An inquiry by the Ministry of Transport was held on Monday, August 29th. The coroner's jury returned a verdict of "Accidental Death."

IT was thirty years ago on August 30th since a fatal accident occurred through an unusual mistake which could have been avoided had the lock-and-block system, in use up to that point, been continued so as to include the signal-box in question. An up train stood in the Charing Cross Station of the Glasgow low-level line of the North British Railway at the same time as the signalman had to deal with a down train. When the latter left the station the man, quite correctly, sent the train-entering-section block signal to the box in advance, but instead of sending the corresponding train-out-of-section to the box in the rear he sent that signal on his up line instrument and so cleared the line for the up train still standing there. The result was that a second up train entered the section and collided with the first. There would not, however, have been an accident had not the driver of the second up train over-run the home signal, which was at "danger." It was, further, twenty years on August 29th since another fatal accident occurred from a cause which it is hard to legislate for, except by automatic train control. A light engine was running from the shed at Nine Elms to Waterloo. Through Vauxhall Station there are eight lines of way and the light engine was on the up main local line, which, reading from north to south, is the fifth road. The home signal for that line was at "danger" as a train was in the station, but the home signal for the up main through line—the sixth from the north—was at "clear" for an approaching passenger train. The driver of the light engine was, however, under the firm impression that, when leaving the shed, he was turned on to the through line, so took the signal, at "clear" for the approaching passenger train, as his and overlooked his own signal. The signals were sufficiently separated as to be distinct from each other and the driver was a man with an excellent record.

## Notes and Memoranda.

IT is said that an 8ft. fall of snow on the roof of a dance hall in the Yoximite National Park, California, represented a load of 156 lb. per square foot.

ACCORDING to G. F. Smith, of the American Chemical Society, one of the most satisfactory means of drying air is to pass it over anhydrous magnesium perchlorate.

IT is said that the cost, in the way of unemployment pay, of holding up work on the new Cunarder is about £14,000, and that some £750,000 has already been disbursed in this useless manner.

IT is suggested by engineers in America that the tinning of the pistons of internal combustion engines, by an electrolytic process, to a thickness of about one-thousandth of an inch, helps materially in the settling down of the engine to running conditions and enhances the life of the running parts.

ACCORDING to *Sheet Metal Industry*, duralumin may be tinned by heating the metal to about 400 deg. Fah., having the surface well cleaned and without using any tinning flux. Heat the tin or tinning alloy to between 500 deg. and 520 deg. Fah., and with the aid of a wire scratch brush briskly rub the molten tinning metal on to the duralumin.

ABOUT half a mile of old gravel road near Baton Rouge, Louisiana, has recently been resurfaced with a diaphragm of asphalt-treated cotton cloth by the Louisiana Highway Department. The theory of the cloth diaphragm is to waterproof the material in the base and, at the same time, bind together the thin wearing coat of asphalt-treated gravel until it is thoroughly healed by traffic.

WORKERS at the Chemical Research Laboratory under the Department of Scientific and Industrial Research have found that the best index of atmospheric pollution is the green colour which appears on copper or bronze exposed to the air. This colour, which is known as verdigris when it is unwanted and as "patina" when the effect is decorative, can, it is said, now be produced artificially by electricity in 15 minutes compared with the 20 years which is necessary under natural conditions. It used to be thought that this colour was produced by pure air, but it has been found that it is almost entirely due to sulphur from city smoke.

IN America the standard test specimen for cast iron is a round bar 1·2in. in diameter and 21in. long. It is bent between supports 18in. apart. It is claimed that the round section eliminates errors from four hard corners; the vertical position in the mould eliminates differences in strength found in flat poured castings when tested cope side up or cope side down. Pouring from the top means giving every inch of the vertical casting molten metal of the same temperature and is the only way of getting this casting as sound as such a casting can be made, the casting practically feeding itself as it is poured. Dry sand for the mould means the elimination of a hardening (strengthening) influence from the dampness of the ordinary green sand.

THE possibilities of the torsion balance as an aid in prospecting under conditions as they exist in Canada are being investigated by the Dominion Observatory, Department of the Interior, working in co-operation with the Geological Survey of Canada and with the Ontario Department of Mines and the Ontario Research Foundation. Surveys have been made at a number of faults near Ottawa, and at the lignite deposit and a deposit of iron ore in Northern Ontario. The results so far obtained show that the instrument, when used in a previously proven mineral area, can furnish valuable information as to the position and extent of underlying ore bodies, thus materially reducing the very expensive operation of diamond drilling.

A BULLETIN entitled "British Columbia Softwoods, their Decays and Natural Defects," has recently been issued by the Forest Products Laboratories of Canada, Department of the Interior, Ottawa. This bulletin deals with the characteristics, properties, and uses of Pacific Coast softwoods, and in language as non-technical as possible describes the various fungi to which these woods are susceptible, as well as the effects of insects and marine borers. A chapter on the anatomy and physiology of a tree assists the reader in following the descriptions of the methods of attack of these fungi, borers, and insects, and the necessary preventive measures to be taken to ensure the proper durability of the different woods. The author draws attention to the enormous waste of timber resources through the decaying of wood, and lists various antiseptics and preservatives found beneficial. Sixty illustrations, many of them coloured, add to the interest of the text and help to identify the results of fungus, insect, and marine borer attacks.

IT is emphatically stated in a recently issued report of the Building Research Board of the Department of Scientific and Industrial Research that "there is no doubt whatever that in this country the action of these [sulphur] gases is the most potent cause of the decay of calcareous building materials." The primary effect of the acid gases is erosion due to calcium sulphate being more soluble in water than calcium carbonate. Magnesium sulphate, one of the products of magnesian limestone, is very soluble. If the action were confined to the washing away of the soluble sulphates, the erosion would be relatively unimportant; but the effects are much more complicated. "The action of the acid sulphur gases on calcareous materials causes the formation of hard, impermeable surface skins, which tend to blister and exfoliate, and thus to cause the development of an ugly type of decay. Since they not only mar the appearance of the stone, but also damage it structurally, these effects are particularly serious." Skin formation does not occur on rain-washed areas, and so blistering and exfolintion are usually confined to sheltered positions. It is stated that the differences in the relative durability of limestones is due to differences in the structure of the stone, and that "the weathering quality of a sample of Portland stone depends largely upon its micro-porosity, and that its durability can be predicted by means of simple laboratory experiments."

## Miscellanea.

IT is announced that the works at Yaroslav, Russia, are now being organised for the commercial production of synthetic rubber.

THE change-over of the telephone system of Cape Town and the surrounding district is expected to be completed by the end of this year.

IT is said that the installation of two new vulcanisers in the Dunlop factory at Walton, Liverpool, has increased the capacity of the works by 7000 shoes a day.

A SHIP channel, 44 miles long, with a depth of 26ft., is being made from San Francisco Bay to the City of Stockton. It largely follows the course of the San Joaquin River.

THE caisson gate for the new dry dock at Southampton, which is to be built by the Furness Shipbuilding Company, will be the largest ever made. It is to be 142ft. by 29ft. 6in. and 58ft. 6in. deep.

RUSSIAN motor car production during the first half of the current year amounted to 9127 cars and lorries, as compared with 7769 and 2448 respectively in the corresponding periods of 1931 and 1930.

RAPID progress is being made with the construction of the new refinery of the Shell Oil Company at Montreal, which is estimated to cost 2,000,000 dollars. The reaction chamber, weighing 68 tons, will have steel walls 5⅛in. thick.

A FLEET of fourteen Leyland double-deck trackless trolley omnibuses is to be put in service by the Llanelly and District Electric Supply Company. The electrical equipment will be supplied by the General Electric Company.

IN the issue of *English Mechanics* for August 19th there is a reproduction of a photograph, taken from an aeroplane on an "infra-red sensitised plate," which shows plainly Mount Shasta, in America, at a distance of 331 miles. The aeroplane was at a height of 23,000ft. when the exposure was made.

THE Saskatchewan Department of Natural Resources has just issued a report by Professor J. B. Mawdsley, of the University of Saskatchewan, Saskatoon, giving a brief outline of the geological history of Northern Saskatchewan, with some prospecting conditions. A copy of this report is on the file at the Reference Library, Canada House, Trafalgar-square, S.W.1.

AFTER being closed for a fortnight for electrical alterations necessary for the change-over to the national grid system, the Skinningrove Steel and Ironworks, Saltburn, were reopened in the middle of August. Four furnaces, damped down when the works closed, have been put into full blast again. The Loftus ironstone mine, owned by Pease and Partners, Ltd., which supplies the works with ore, also was reopened after being idle for two weeks.

THE new National Research Laboratories at Ottawa, which have cost 3,000,000 dollars, have been officially opened. Two of the principal laboratories are the heavy testing laboratory and the electrical laboratory, both two storeys in height and equipped with travelling cranes of 15 tons capacity. In addition to numerous laboratories, a feature of the new home of the research organisation is a library with accommodation for 300,000 volumes.

BY arrangement with the Aire and Calder Navigation, the L.M.S. Railway has recently completed an extensive scheme comprising sidings and cranes at the North side of the West Dock at Goole. The shed measures 502ft. long by 75ft. wide; there are four sidings, each approximately 560ft. long, and in the centre of them there is an electrical traverser passing over all the four lines of rail. There are also two sidings approximately 1040ft. long laid on the quay side in front of the shed. The shed is equipped with five 30 cwt. and one 5-ton longitudinal electric travelling cranes, each with a span of 70ft. 7in. On the quay side there are eight 3-ton portal electric level luffing cranes with a minimum and maximum rake of 20ft. and 53ft. respectively.

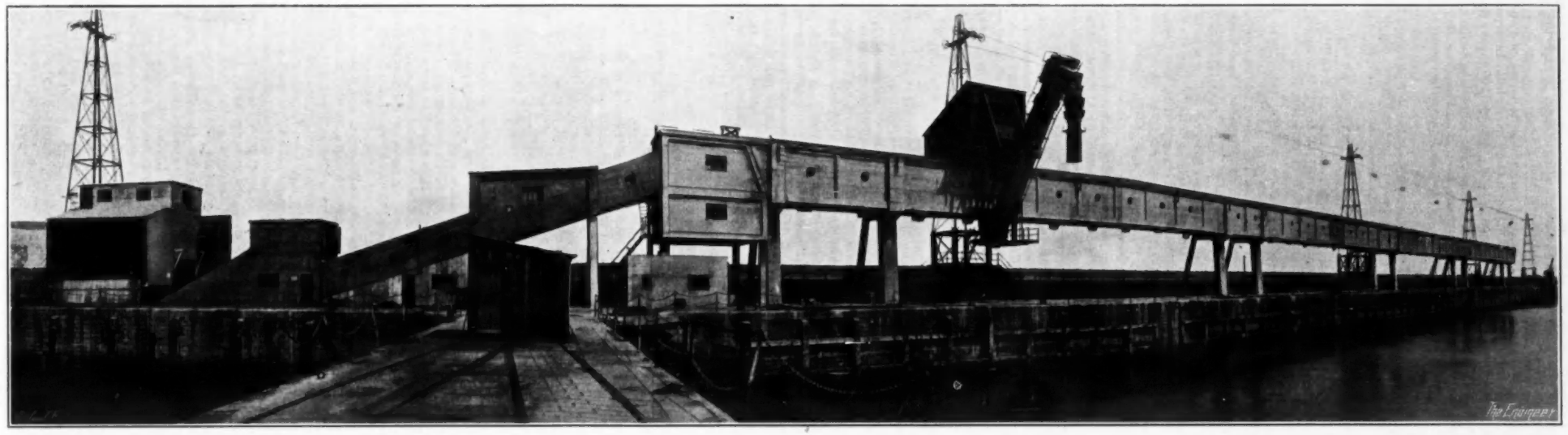
A CONTRACT has been entered into, says the *South African Mining and Engineering Journal*, between the S.A. Coal Estates and the S.A. Iron and Steel Industrial Corporation for the supply of washed coal from the Navigation pit at Witbank to the works at Pretoria. This contract is the result of the extensive research work, including coking tests on a commercial scale, that have been carried out in England and on the Continent during the past year on washed Transvaal coals, and these tests have proved the superiority of Navigation coal for coking. The Coal Estates have decided to erect a large washing plant at the Navigation Colliery to supply washed coal under the contract, and as soon as the steel works start operations the S.A. Coal Estates will benefit considerably. The blast-furnace coke to be used at the steel works will contain 75 per cent. of Navigation coal and 25 per cent. of Natal coal. It is estimated that after crediting the coking process with the revenue from the sale of coking by-products the net cost of the coke compares favourably with the average coke cost in Europe.

THE report of the Government Mining Engineer of South Africa shows that in 1931 the Vereeniging Works of the Union Steel Corporation produced 35,416 tons of manufactured steel, valued at £368,290, while plants for the manufacture of copper wire, solid and hollowed drill steel were laid down. Including the blast-furnaces at Newcastle, it is stated that the average labour employed by the Corporation was 337 European and 721 coloured persons. The Dunswart Iron and Steel Works, Ltd., is reported to have produced 2451 tons of wrought iron bars and other sections, valued at £31,863; 3891 tons of steel bars, rails and other sections, valued at £58,365; while steel castings totalling 1211 tons, valued at £60,550, were the output of the foundry. The firm of G. Stott and Co., Ltd., manufactured sections totalling 3907 tons of wrought iron, valued at £46,884; while from the Witwatersrand Co-operative Smelting Works there came 5770 tons of shoes and dies, valued at £69,240, and 1494 tons of steel balls, valued at £17,928. The steel produced during 1931 amounted to 47,782 tons, as compared with 43,631 tons in 1930.

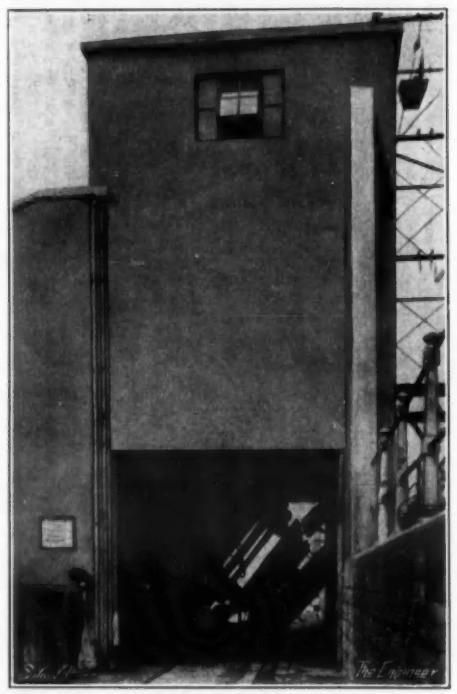
# MECHANICAL COAL HANDLING AND SHIPPING PLANT AT DOVER

THE FRASER AND CHALMERS ENGINEERING WORKS, ERITH, ENGINEERS

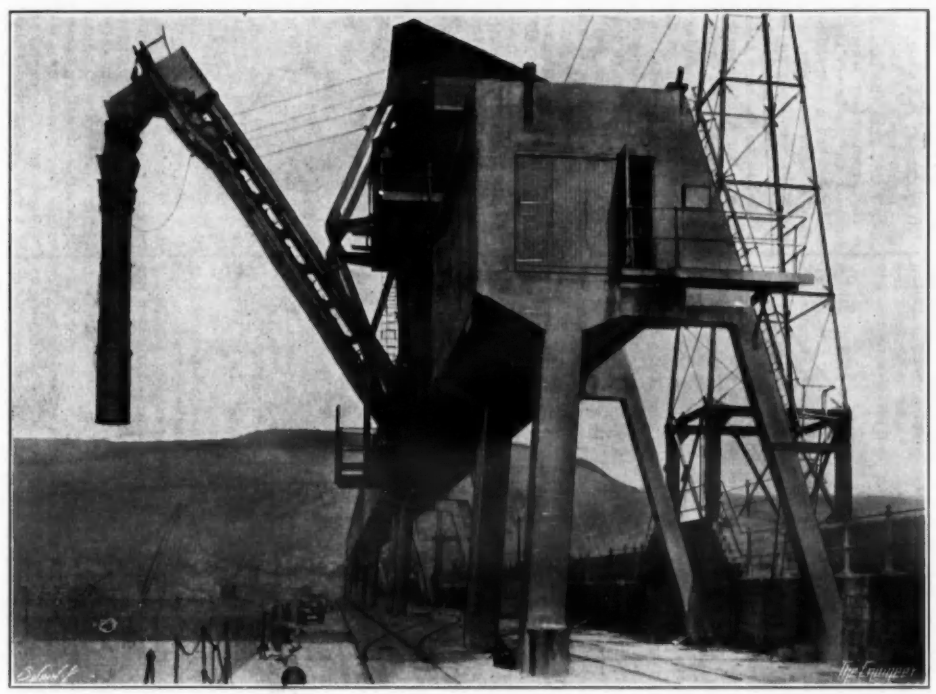
(*For description see page* 229).



PANORAMIC VIEW OF THE COALING PLANT WITH TIPPLER ON THE LEFT AND THE LOADER IN THE CENTRE



THE TIPPLER



THE LOADER RAISED TO CLEAR SHIP'S RIGGING

THE WHARF

# The Engineer

*SEPTEMBER 2, 1932.*

VOL. CLIV. No. 3999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### NOTICES TO READERS.

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## COMPULSION AND PROGRESS.

A LITTLE sentence which sets up a long train of thoughts may be found in this week's letter from our Paris correspondent. He mentions that the Commission des Mines et de la Force Motrice is urging the French Government to issue a decree that all commercial motor vehicles must use a petrol-alcohol mixture during the warm months. It is very important to the French that fuel alcohol should be used, and it is held that, since the technical difficulties have been surmounted, it is only necessary to overcome prejudice. No doubt there will be considerable opposition to that decree and, if issued, we anticipate that it will be not infrequently evaded by a race which has not that respect for law which is ingrained in the English temperament. The petrol and fuel oil interests will associate themselves with drivers in protest against it and all the old and some new arguments against alcohol will be advanced and will have to be overthrown again. We shall, no doubt, hear also that any attempt of the Government to dictate what fuel shall or shall not be burnt is a gross and unwarrantable interference with the rights of the user. Yet if a larger view be taken it cannot be denied that a good deal may be said in support of a decree which would help to foster a national fuel industry that may far outweigh in importance the inconvenience of commercial vehicle drivers or the interference—probably not very great—with the commerce of the fuel oil and petrol firms and merchants.

It is a little unfortunate that this example of the effects of compulsion upon progress should be associated with the motor vehicle, which has suffered much at the hands of the law-makers and whose history, in this country at least, was completely arrested for many years by an Act of Parliament. But if we refuse to allow our judgment to be warped by a few selected cases in which restriction and compulsion have done more harm than good, we may find many, even in connection with motor cars, in which, often despite seeming hardship, they have been not only beneficial to the public or to national economy, but have encouraged technical progress. The once deeply resented regulations prohibiting the emission of smoke from factory chimneys may be cited as a case in point. The object aimed at was the purification of the atmosphere, but the reduction of smoke implies better combustion and improvement of boiler firing resulted. The emission of dust and noxious fumes is, we believe, generally controlled by civil process or by individual arrangements. But there again boiler engineering will in the long run gain by the compulsion which is put upon it to cleanse the discharge from chimneys. The dust is either unburnt coal or cinders partly composed of incombustible material which should not be there. Hence the prohibition of dust emission will encourage the search for higher furnace efficiency and the use of nothing but clean coal in the pulverising mills. It is more difficult to see how directly beneficial results to the boiler plant can arise from the removal of noxious fumes, but the matter is so new that we would hesitate to regard the regulation as entirely opposed to the interest of the boiler owner. Let us turn to other subjects in which the engineer works under certain compulsory regulations. Noise is another public nuisance. In other countries than this there are decrees controlling its amount, and as far as motor vehicles are concerned there are British laws. The compulsory observance of those laws cannot but lead to the improvement of mechanism, the withdrawal of worn-out and inefficient machines, the reduction of damage suffered by ill-packed loads, and the saving of road surfaces by the disappearance of racketty vehicles. A few years ago the use of pneumatic riveters on the construction of a steel-frame building in America was prohibited owing to the proximity of a hospital. That prohibition directly encouraged progress in the utilisation of electric welding for constructional purposes. The compulsion that is put upon engineers by Government Departments, such as the Board of Trade, the Home Office, the Ministry of Health, the Ministry of Transport, and so on, often appears to be irksome and sometimes unintelligent, but, on the whole, by setting up high standards the good that it does more than balances the burdens imposed. Many, if not all the regulations issued by these departments have been drawn up with a view to the preservation of the lives and limbs of His Majesty's subjects, and if they have erred at all the fault has been on the right side. There can be little doubt that the great reputation for trustworthiness enjoyed by British engineering products is due in no small degree to the standards of excellence which have to be attained to meet the requirements of such authorities.

Every engineer is acquainted with regulations which affect his own undertakings and business, and not infrequently he rebels against them, particularly when he finds himself in competition with others who are outside the law. But, certain exceptions apart, we suggest that the principal defect of such regulations is that they are not revised at sufficiently short intervals and consequently fail to recognise advances that have been made. To take a single example, the progress of welding in this country may lag behind that of other countries if authorities continue to discountenance it, or to insist upon the observance of the old regulations until the art has advanced sufficiently far to admit the formulation of new rules. The freedom with which America is making welded pressure vessels is in sharp contrast to the backwardness of this country in that craft. But, provided that revision of regulations is not unduly delayed, we think there can be no question that by setting up standards of excellence a little bit ahead of the general practice of the day they tend to encourage progress. It may be said that individual effort would attain the same end, but it cannot be overlooked that individuals think first of their own interests and in consequence do not take the wide views that may be dictated by the interests of the country as a whole. Some of them will always be ahead of their times, but others will be behind them. Insistence on minimum requirement, therefore, causes a levelling upwards, and unless, as sometimes happened, the standard is unnecessarily high or in other ways obstructive, a general improvement takes place.

### Unfair Competition.

IF a hundred manufacturers were asked what was the chief cause of their present difficulties, ninety-nine, after reflection, would be likely to lay the blame on excessive competition. They might not all employ these particular words. Some would perhaps direct their complaint against the prevailing lowness of prices, others would give as a reason the scarcity of orders or the unbearable height of taxation. None, however, would deny that these things were, in a sense, secondary evils, which could either be remedied or borne were competition less acute. There is an old axiom that competition is the soul of trade; but, if so, it is a soul which is sometimes very uncomfortable for the body which it animates. It might, perhaps, be better likened to one of those obscure biological products which regulate the life of organisms. One can very easily have either too little or too much of it. Suppress it, and the industrial system is liable to succumb to lethargy and inanition; let it become too active, and there is equal danger of feverishness and collapse. A reasonable amount only is consistent with a healthy industrial life. But even those who believe that the unrestricted emulation of rival manufacturers to extend their business by selling better or cheaper goods than their neighbours is the most effective agent of progress, and who, therefore, look with distrust on all attempts to stop this rivalry by means of trusts, cartels or monopolistic combinations, are of one accord in condemning unfair competition. This unanimity, however, does not signify very much. Unfairness is one of those words that Huxley might have called "polarised," and, therefore, disturbing to an argument by reason of the prejudice which it imports. Unfairness in trade, as in other matters, is always to be condemned. The difficulty arises as soon as one tries to define what is fair competition and what is not. In one sense no competition is fair. If all individuals were equally endowed and given equal chances, every race would end in a dead-heat and every contest in a draw. But, since the object of such competitions is to demonstrate the superiority of some participants over others, the requirements of fairness are held to be satisfied if identical conditions are imposed on all. In the field of sport such matters have long been settled, even internationally, and complaints of unfairness are rare indeed.

In the field of business it is, unfortunately, otherwise. Unfair competition is a term in everyday use, general enough, indeed, to tempt a cynic to remark that it might connote nothing more than the greater efficiency of a rival's methods. But the question cannot be dismissed so easily. Nor do we do much to lessen its difficulty by excluding from consideration all complaints of unfairness based upon offences against the standard of business honour. It is, of course, possible for firms to compete unfairly by making unjustifiable claims for their products, by giving guarantees improbable of attainment, or by injurious suggestions concerning their rivals; but, happily, such cases are rare, and Nemesis, inexorable, is never far behind. The real heart of the trouble lies in a kind of competition which breaks no laws, written or unwritten, and offends no code of honour, however strict. It may be legitimate in every sense of the word, honest and above-board, yet nevertheless unfair in the eyes of those who suffer from it. An instance, which will illustrate the point, may be mentioned. It was given recently, by the chairman of a large electrical engineering company in his speech at the annual meeting of the shareholders. His complaint was of what he called the unfair competition of smaller firms, which, with no costly research departments to maintain, no highly paid designing staff and the minimum of overhead charges, could manufacture ordinary electric motors at prices impossible of attainment by firms carrying the equipment and the staff essential to the technical progress of the industry. From his point of view there was an injustice, and most people in a similar position would feel the same. It may be argued that he could have established a works to manufacture on exactly the same lines as his competitor, and could have reaped therefrom an equal profit. But to produce at his competitors' prices these works would have to be free from any share in the overhead expenses of the parent factory, so that the latter would remain in the same invidious position, deprived of a profitable routine trade and left to bear the costs of its own expensive organisation. If such competition is unfair, what can be said of that from foreign firms paying much lower wages than are current in this country and taxed far less heavily? This problem is already acute, and although it may be alleviated by the slowly rising standard of living so far as the industrial countries of Europe are concerned, it must in a few years be intensified beyond measure by competition from Asiatic and Indian labour. The countries, in which the man who "wants but little here below" and will work hard twelve hours a

day to get it is counted by hundreds of millions, are becoming industrialised much more rapidly than is generally realised, and every new factory established is one more warning to our statesmen and economists that the question as to what is fair competition and what is not will have to receive a practical answer.

If we endeavour to eliminate prejudice by refusing to discuss fairness, and by examining all competition in the light of its economic expediency, we are on surer, if almost equally difficult, ground. In the case of the electric motors, mentioned above, it would seem better for the industry as a whole that the firms to which it looks for technical progress should not be at the mercy of others who reap, but take no part in the sowing. Yet any attempt to prevent this sort of thing would not only interfere with freedom of enterprise, but might easily, in the long run, prove injurious to progress. Every restriction of free competition is, in some way, a restraint of trade, which most economists hold, in principle, to be bad. Progress is impossible without change, and change is nothing but the successful competition of the new with the old. Every time a battle has been won, we congratulate ourselves on the advance, forgetting the destruction of values which has necessarily taken place. Industrial history is almost as much a story of ruined enterprises as of successful ones. The stage coach, the sailing ship, the reciprocating steam engine, have all gone down under the stress of competition, the electric tramway seems doomed, and even the locomotive is struggling against desperate odds. Each, in its turn, has cried out against unfair competition, yet it has had to meet the competition or go under. The most we can do is to have the foresight to see what is inevitable and to allow it to come about with the least economic shock. Almost every new industry has been developed by the ruin of some older kind, and it is only a question of time before its own turn will come to meet new competition or die. Whether, therefore, this competition be called fair or unfair is a small matter. The important thing is that, when this time does come, the industry and those engaged in it shall possess that adaptability which will alone give them a chance to survive.

## The British Association.

No. I.

SPECIAL interest attaches to the meeting of the British Association this year, from August 31st to September 7th, in York, for it was in York in 1831 that the British Association was founded. It was in that year that David Brewster suggested to John Phillips, the Secretary of the Yorkshire Philosophical Society that a "British Association of Men of Science" should be created, adding that as the Yorkshire Philosophical Society was already established and flourishing, York should be the centre in which to hold the first meeting. All the scientific societies then known were circularised, there being thirteen in London and twenty-six elsewhere throughout the country, Yorkshire claiming nine. Thus it came about that it was in the premises of the Yorkshire Philosophical Society that on September 26th, 1831, the British Association held its first meeting, the officers of the Society being elected as the officers of the Association. The meeting went on for several days and the classification of the papers indicates that the foundation of the present organisation in that respect, at any rate, was well and truly laid. There were six on geology and mineralogy, five on magnetism and electricity, four on optics, three on light and heating, two on chemistry, and others on physiology and meteorology. The Association met again in York in 1844, 1881 and 1906, and in returning to the place of its birth after a century of existence it is apt to recall what Sir Roderick Murchison said at the close of the meeting in 1831: "To this city, as the cradle of the Association, we shall ever look back with gratitude, and whether we meet hereafter on the banks of the Isis, the Cam or the Forth, to this spot we shall still fondly revert and hail with delight the period at which, in our periodical revolutions, we shall return to this, the point of our first attraction."

Although, naturally, the meeting in York this year will lack something of the glamour of the centenary meeting in London last year, it promises in the matter of attendance and in other respects to be well up to the average of ordinary years, and a large number of scientists are coming here specially to attend the meeting from America, France, Germany, Italy, Sweden and Holland.

As usual, our interests are mainly centred in Section G (Engineering), and with an electrical engineer in the person of Professor Miles Walker, F.R.S., as President, it follows that a large proportion of the papers are on electrical subjects. Indeed, the programme of papers in this section is heavier than usual, and actually runs into the Wednesday of the week following the opening of the meetings, whereas usually it closes on the Tuesday.

Sir Alfred Ewing, F.R.S., President of the Association, delivered his Presidential Address on Wednesday, August 31st, and we give some excerpts from it on page 228.

*(To be continued.)*

## Literature.

*The Calculation of Heat Transmission.* By MARGARET FISHENDEN, D.Sc., F. Inst. P., and OWEN A. SAUNDERS, M.A., M.Sc. London: H.M. Stationery Office. 1932. Price 10s. net.

IN a foreword to this volume the late Sir Richard Threlfall explains that its preparation was undertaken by the Fuel Research Board at his suggestion in order that the principles underlying furnace design should be presented to engineers in a usable form. He expresses satisfaction with the work accomplished, but trusts that the Board will continue its labours "until the final goal of providing engineers with a treatise on the subject which they can use in actual practice is reached." The phrase we have quoted will warn engineers not to expect too much from the title of the book. They will find in it abundance of information relating to the transmission of heat by radiation, conduction, and convection; but the application of this knowledge to the design of furnaces or of any other engineering apparatus is a matter for themselves. The authors have so far disregarded the practical aspects of heat transmission that from cover to cover of the book there is not a single illustration of a furnace, boiler, economiser, superheater, air heater, feed heater or condenser, nor does the index even notice the existence of such things. The designer, therefore, will look in vain for any kind of direct guidance, whatever be the kind of apparatus he is concerned with. If, however, he comes to his task already well equipped with experience and practical knowledge he may derive considerable benefit from the data and laboratory experiments which bear upon any particular problem.

The book does not claim to extend our knowledge of heat transmission. It is not based upon any new investigations and contains no new theories. The object of the authors has rather been to collect in a convenient form the results of the most important experimental work scattered through the technical literature of the world, and to correlate these results as far as possible. Radiation, conduction, and convection are considered separately, and at the end of the book is a chapter illustrating the application of some of the results to particular cases. The presentation of the whole subject is systematic and the labour of compilation must have been heavy, for the bibliography contains 198 references to original publications which have been consulted. As a digest of this quantity of often more or less inaccessible information the volume is to be commended, although its apparent impartiality towards the results of so many investigators makes one wonder whether all of their work was really comparable in value. Much of the book, also, deals with questions of little more than academic interest. An engineer, for example, can rarely be concerned with "The heat flow in an infinitely thick slab at a uniform temperature $t_o$ when the surface is suddenly altered to, and maintained at, a temperature $t_1$," or with what happens "when the temperature at the surface of a plane slab is made to undergo simple harmonic oscillations of period $\tau$." Somewhat more practical is the problem of the time taken to heat up a thick slab of steel in a furnace, but any forge foreman would be able to give the answer right away and his judgment would probably be more reliable than the calculation. The question of the time taken for heat to travel through a furnace wall is also considered. One is not often called upon to notice this quantity, because it is rarely that anything depends upon it. It does, therefore, seem rather surprising that more than seven hours would have to elapse before there is any temperature rise whatever on the outside of an 18in. refractory wall, subjected on the inside to gases at 2000 deg. Fah. moving at 30ft. per second, as well as to the radiation from a parallel wall maintained at 2000 deg. Fah. This, however, is what the calculation shows. It is further demonstrated that the wall will still be getting hotter even after thirty hours from the start.

Although boilers and condensers constitute such very important fields for the application of knowledge concerning heat transmission, the designers of such apparatus will be disappointed if they look to the present book for much assistance. The chapter on "Heat Transfer Calculations" contains no examples pertinent to boiler or condenser design, and it is by no means easy to extract much help from the more theoretical chapters. The method adopted by the authors to correlate the various experimental data on heat transmission to tubes by convection is to plot the non-dimensional functions log $(H\,d/k\,\theta)$ and log $(V\,c\,d/k)$ against each other for every series of experiments considered. In these functions H is the coefficient of heat transfer, V the velocity of the gas, $d$ the diameter of the tube, $c$ the specific heat per unit volume, $k$ the thermal conductivity of the gas, and $\theta$ the temperature difference between the surface and the gas. The resulting diagram contains a sheaf of more or less parallel straight lines plotted against ordinates, the significance of which does not leap to the eye, to say the least of it. The method may be all very well for those who want merely to see how experimental results look when compared in this way, but the designer is left with the job of deciding which line may best apply to his particular case and what reliance he can place on any deductions from it.

Quite as ineffective, from the practical point of view, is the information relative to condensers. The transfer of heat from the steam to the tube and from the tube to the water are dealt with in separate sections. As regards the former, the reader has the choice of coefficients of heat transfer between 200 and 5000, according to which experimenter he prefers to trust. The transfer of heat from the tube to the water is then studied by means of non-dimensional functions in the manner indicated above. The authors appear to be entirely unaware of the important work of Mr. H. M. Martin on heat transmission in condensers. Mr. Martin not only explained the erraticalness of many carefully determined experimental results by the hitherto unsuspected influence of air dissolved in the circulating water, but also developed for the first time a rational method of proportioning tube surfaces. The omission of all reference to this work is as difficult to understand as it is regrettable in a book of this nature, for it suggests that the survey of authorities is less complete than could be desired. If, however, one takes the volume for what it is, and does not judge it by the standard of what it might have been, it may be considered a useful compilation. But we still wait for a treatise of a more practical nature.

### BOOKS RECEIVED.

*Surveying.* Third edition. By W. N. Thomas. London: Edward Arnold and Co., Ltd., 41–43, Maddox-street, W.1. Price 25s. net.

*British Rainfall*, 1931. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C.2. Price 15s. net.

*Outline Notes on Telephone Transmission Theory.* By W. T. Palmer. London: *Electrical Review*, 4, Ludgate-hill, E.C.4. Price 5s. net.

### SIXTY YEARS AGO.

To the scientific and the lay mind alike the study of meteorites possesses a fascination and a certain element of awe. The feeling with which we approach the subject can be traced perhaps to the fact that these bodies are the only portions of the outside universe which man may handle and examine at close quarters. They seem, too, to link the past with the future and to tell a tale of a shattered planet and of the fate which one day may be the earth's. It is calculated that from ten to twenty million meteorites fall into the earth's atmosphere every day. Most of them are minute and many of them descend unnoticed as dust. Occasionally, however, one weighing several tons strikes the earth, such as that which fell with devastating results in Siberia about twenty years ago, or the still greater one which is supposed to exist beneath the surface in Arizona. Frequently the bodies are found in concentrated groups, suggesting that they had reached the earth in the form of a shower or that a large meteorite as it passed through our atmosphere had exploded into a large number of fragments. A noteworthy find of such a meteoric family was made last year at Henbury, in the very centre of Australia. In all 1350 pieces were discovered. Every one was composed of a nickel-iron alloy. Their weight ranged from a fraction of an ounce to 170½ lb. A dimly remembered native tradition of evil hangs about the place. Of all the great meteoric showers which have been discovered, however, that found at Ovifak, west of Fortune Bay, in Greenland, in 1870, must be given precedence. Samples of this shower were brought home by the Swedish expedition under Baron von Otter, and in our issue of September 6th, 1872, we gave an account of the results revealed on their examination. The shower, it seems, was distributed over an area of some 200 square miles. Some geologists maintained that the "meteorites" had not descended from the heavens, but had been erupted from the bowels of the earth. Their argument was apparently based on the fact that the nickeliferous iron was in some cases found enclosing portions of basalt identical with that occurring naturally in the neighbourhood or filling cracks in the rocks. Those in favour of an extra-mundane origin of the bodies pointed out that in other cases the nickel-iron was found together with pebbles embedded in an outside layer of basalt, and suggested that after the shower had fallen there had been a local eruption of basalt which had flowed over and coated some of them. In addition, close beside the iron masses which were embedded in the basalt, were found fragments of rock which were not basalt, but which, except for the fact that they were non-metallic, closely resembled meteorites. We do not know whether it was familiar knowledge in those days that all meteorites are not metallic and that a minority of them are of a stony nature. That fact would have gone a long way to support the views of those who argued that the bodies were really meteorites. The strongest evidence in favour of that opinion which was forthcoming at the time was provided by the results of chemical analysis and examination. It was found that the iron, when heated, evolved gases amounting in volume to about one hundred times that of the body itself. This gas burned with a pale blue flame and on analysis was found to consist almost wholly of carbon monoxide. A typical analysis of a specimen showed that it contained, in round figures, 80½ per cent. of iron, 1·2 per cent. of nickel, a little cobalt and phosphorus, nearly 3 per cent. of sulphur, 3·7 per cent. of carbon, and over 11 per cent. of oxygen. Carbon, the element of life, in a meteorite? What a sublime text it might have been for a Victorian iconoclast!

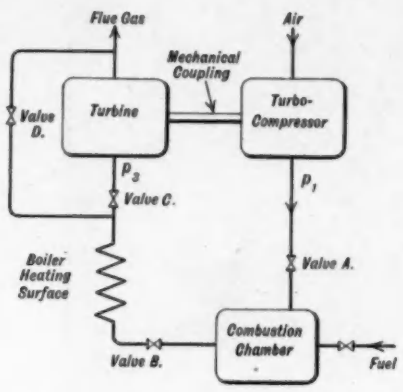
## Letters to the Editor.

*(We do not hold ourselves responsible for the opinions of our correspondents.)*

### OVER 100 PER CENT. EFFICIENCY.

SIR,—I have read with interest your leading article "Over 100 Per Cent. Efficiency," and also your article "A High Gas-Velocity Boiler," and it certainly seems to me that the claims made by Brown-Boveri for a boiler efficiency of over 100 per cent. are not beyond the bounds of possibility.

The cycle envisaged by Brown-Boveri is roughly indicated in Figs. 1 and 2 below. Air is compressed in the turbo-compressor from atmospheric pressure $p_0$ to $p_1$.




"THE ENGINEER" FIG. 1.

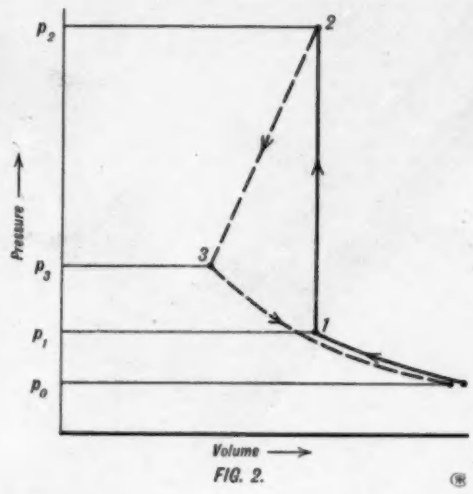



FIG. 2.

This air is then admitted to a combustion chamber *via* valve A, valves B and D being open at the same time, so that the incoming air forces out the products of combustion left in the combustion chamber from the previous cycle. When the combustion chamber is full of fresh air valves A, B, and D are closed, and fuel is then admitted and ignited, the pressure in the combustion chamber thus rising from $p_1$ to $p_2$. Valves B and C are now opened, so that the products of combustion first pass over the boiler heating surface at high velocity and then are expanded in the turbine to atmospheric pressure $p_0$.

It will be noted that the gas in passing over the boiler heating surface may be cooled down to a temperature lower than that of the air leaving the turbo-compressor, and also that the temperature of the flue gas leaving the turbine may be below that of the air entering the turbo-compressor. This process is roughly indicated by the dotted lines in Fig. 2, $p_3$ being the pressure at inlet to the turbine.

To continue the cycle: when the pressure in the combustion chamber has dropped to approximately $p_1$ there will still be some flow of gas into the turbine owing to the "momentum" effect of the gas passing over the boiler heating surface, but at this point, in order to complete the exhaust of the products from the combustion chamber, it is necessary to shut valve C and open valve D, by-passing the turbine. Valve A is then opened and the cycle again recommences.

It is clear that, in order to secure approximately even flow through the turbine and through the turbo-compressor, there must be a number of boiler units in parallel, each equipped with its own combustion chamber and set of valves as described above. Then by a suitable arrangement of the phase relationship of one boiler unit with another an approximately constant flow rate can be maintained through the one turbine and turbo-compressor unit.

Now, the point which does not seem to have been appreciated in your leading article is that the above cycle enables $p_2$ to be considerably greater than $p_1$, so that it is possible for the turbine to drive the turbo-compressor without any external power supply; and further, that this may still happen, even though the temperature of the flue gas leaving the boiler is below that of the air leaving the turbo-compressor, so that the temperature of the flue gas leaving the turbine is below that of the air entering the turbo-compressor.

As you rightly show in your leading article, for the turbine unaided to drive the turbo-compressor the temperature rise across the turbo-compressor must be very nearly equal to the temperature fall across the turbine, if it be assumed that the gas rate × the mean specific heat of the gases is the same for the turbo-compressor and for the turbine. On this assumption the following simple example seems of interest.

Take the pressure at the delivery of the turbo-compressor $p_1$ to be 2 atmospheres absolute pressure, and the temperature of the air entering the turbo-compressor to be 20 deg. Cent. Assume the adiabatic efficiency of the turbo-compressor to be 85 per cent. and the adiabatic efficiency of the turbine, including by-passes D, to be 85 per cent. Finally say that the mean temperature of the flue gas discharged to atmosphere shall be 10 deg. Cent.

Then on this basis the temperature of the air leaving the turbo-compressor will be 95·5 deg. Cent. and the temperature of the gases entering the turbine will be 85·5 deg. Cent. The pressure required at inlet to the turbine will be 3·33 atmospheres absolute pressure, which seems quite feasible in view of the fact that the pressure after explosion $p_2$ should be about 8 atmospheres absolute.

It should be noted that the temperature of the flue gas leaving the turbine will be about −15 deg. Cent., the mean flue gas temperature at discharge of 10 deg. Cent. being attained after the flue gas leaving the turbine has mixed with the flue gas which has passed through the by-pass valves D.

It may be remarked that an adiabatic efficiency of 65 per cent. is too high for the turbine with its by-pass valves D. Just what this efficiency will actually be clearly depends on the percentage of the total flue gas by-passing the turbine, and the determination of this percentage is clearly one of the subtleties of the new cycle.

Another complex problem is the deposition of moisture from the flue gas, this being further complicated by the presence of oxides of sulphur and of ash particles in the flue gas. In fact, the latter factors may well be the determining ones with regard to the practical possibilities of the new Brown-Boveri boiler.

It may be noted that Messrs. Brown-Boveri claim for their new types of boiler very considerable reductions in weight, space, and capital cost; but that so far as the overall efficiency of a complete power plant is concerned they do not claim any increase in efficiency above that obtainable by the most advanced practice of to-day, since with their new types of boiler they do not propose to use either high pressures, high temperatures, reheat, or regenerative feed heating.

A. H. WARING.

Norton-on-Tees, August 28th.

### A MODERN CONCEPTION OF STEEL QUALITY.

SIR,—Mr. H. W. Graham's paper, "A Modern Conception of Steel Quality," reproduced in your issue of August 19th, 1932, suggests that steel possesses twin properties which upon a purely engineering as distinct from a metallurgical basis may be classified as:—

(*a*) Elasticity, which is possibly intrinsic to carbon content and probably a fixed characteristic for a particular grade of steel, and method of production; and

(*b*) Plasticity, which is probably dependent to a large extent on the various alloying elements and inclusions and upon the solidifying conditions and subject to considerable variation by cold work.

Considering first of all the intrinsic elastic characteristic, we may safely say that stress is some function of elastic strain, and as a basis for consideration even express the relation in a general form as:—

$$p=(1+s)^e-1,$$

where

$p$ = ratio of stress to breakdown stress of the material in tension,

$s$ = ratio of strain corresponding with $p$ to the elastic tensile strain at breakdown. NOTE.—Negative values of $p$ and $s$ denote tension and positive values denote compression in the above equation.

$e$ = an exponential expressing the intrinsic elastic property.

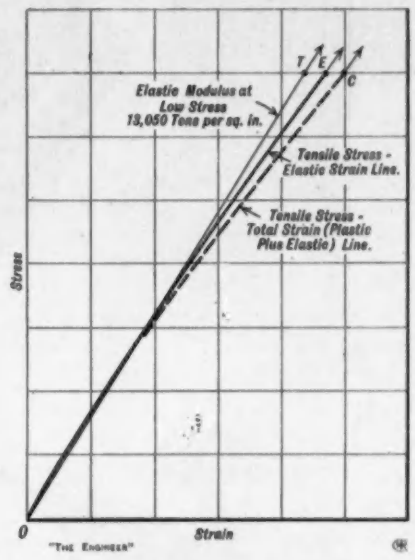
According to the usual interpretation of Hooke's Law, it would be insisted that this exponential $e=1$, *i.e.*, that stress ratio is equal to strain ratio for all elastic materials, but this is quite unsupported by the results of modern research. It appears to be true of wrought iron and specially heat-treated mild steel and nearly true of ordinary rolled structural sections, for which the value of $e$ is probably 1·05 or 1·10.

It is palpably untrue of grey cast iron, for which the value of $e$ is approximately 2·20, and is probably untrue of cast steel and high-carbon steels, for which the value may be from 1·4 to 1·6, though test data are almost entirely lacking.

Considering now the second component, plasticity—cold work may remove some of the plasticity by impressing a permanent set in the steel. Beyond this it is difficult to be precise, since test data are lacking. Cases are reported where a high-tensile steel shows a lower fatigue strength than a low-carbon steel. It may be that the difference is due to the different plastic characteristics of the two materials rather than to the elastic character.

The importance of studying separately, so far as is possible, the plastic and elastic characteristics of steels is strongly urged. The purpose of this letter is to show that unless a broad conception of elasticity such as that given above be investigated it becomes a matter of impossibility to make a true study of plasticity.

For in the accompanying figure, if O T is the approximate elastic modulus at low stress of a material, the tensile




stress-elastic strain line of which is O E and of which O C is the total strain (plastic plus elastic) line, then E C is the plastic component which is to be studied and not the total divergence, T C, from straight-line conditions (Hooke's Law), which includes some of the elastic with the plastic component.

A. C. VIVIAN.

Middlesex, August 24th.

### NOISE AND ITS EFFECT ON INDUSTRY.

SIR,—Sound may be divided into three categories—strident, neutral and soothing. In the first class come such thing as gunfire and the sound produced by certain machinery, such as that engaged in slate quarrying. In the second, sounds such as the purr of rubber tires on the road or the rumble of railway carriage wheels, which are not definitely offensive, and thirdly, the pleasing sounds of life—music, with certain exceptions, and the flow of water. It will be admitted that many sounds, chiefly of a staccato nature, such as thunder, explosions, &c., induce alarm, which cannot be wholly mitigated, even when their source is harmless and understood, such as the backfire of a car.

In order to produce noise, energy in some form or other must be expended. It should be the first step to see that this energy is not misplaced. If a rivet be hit with a hammer the noise will be incidental to the operation; but if a motor car engine seize up, through lack of lubrication, the screaming sound evolved is definitely the misapplication of energy. A rolling mill improperly lubricated, or where the rolls are out of alignment, will consume more power than a similar one properly set and lubricated, and, in addition, it will be much more noisy.

So the first great argument against noise is forged—Noise represents loss of power. But the problem of noise does not end here, for the new machines are, in many cases, silent and well lubricated, so that on this footing the volume of noise would tend automatically to decrease.

The problem of noise is, as much as anything, a problem of wave length, and here it is necessary to relate two incidents which have a bearing on the case.

The first, reported in the Press, concerns a certain type of aero engine which made such an abominable noise that no pilot could be expected to endure it for long. The solution proved to be the provision of a second engine which also produced an appalling noise, but on an entirely different wave length, and the two practically cancelled each other when run together. The second relates to a machine built to order. It was found on completion to be extraordinarily noisy, except from a point to one side of it—yet apparently all the fittings were accurate. In consequence, the customer was skilfully piloted to the quiet side when he came to inspect it.

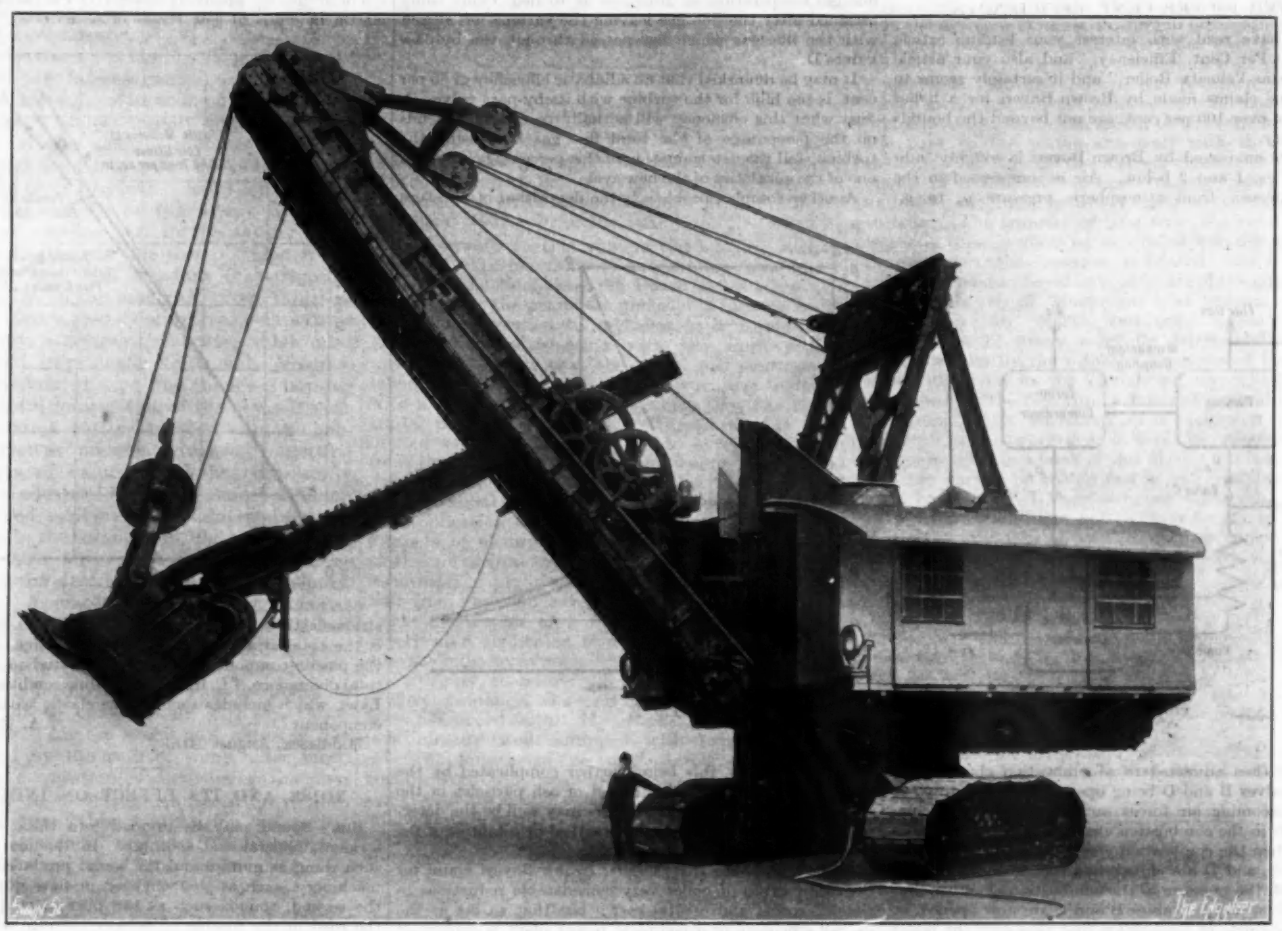
Now, it is the firm belief of the writer that industrial noise could be enormously reduced by intelligent shop planning and arrangement of machinery, provided a few data as to this problem of wave length could be placed at the disposal of engineers. We have been on the fringe of it for years—the sounding board over the pulpit, the provision of wooden setts in the streets, show that however dimly we have realised it, we knew that sound could be controlled after it had left its source, long before the discovery of wireless turned that knowledge into certainty.

And why should we control it? The first conclusion reached was that certain forms of noise meant loss of machine power. The second conclusion is that strident noise impairs the man or woman power of a factory. Shell-shocked men are merely an exaggerated case—our factories are filled with machine-shocked men, though they may not realise it themselves.

It is a well-known fact that no two shops, even if engaged in the same industry, are entirely similar, and this applies also to the volume of noise. In one the noise

## LARGE ELECTRICALLY-OPERATED EXCAVATOR

RANSOMES AND RAPIER, LTD., IPSWICH, ENGINEERS



may be an orderly hum, to which even a stranger may become attuned after a few minutes therein. In another the sound will be so harsh that one leaves it with a feeling of relief.

The purpose of this letter is to focus attention upon the problem of noise and, in consequence, any recommendations are put forward with considerable reserve.

Apart from such noise as results from friction in one form or another, the points for consideration are as follows :—

(1) The floor, with special reference to the material of which it is made. It is possible that a floor composed entirely of one material, *e.g.*, concrete, might conceivably be more conducive to noise than one in which different materials were used. I say quite frankly that I do not know, but it is at least a point worthy of examination.

(2) The alignment of the machines on the principle of the aero engines already referred to and for this data would be required, probably involving research.

(3) The roof :

(*a*) The material, viz., corrugated iron or asbestos, slates, &c.

(*b*) The height of the roof and the angle.

In general, it would be well to aim at rythm of noise even if it cannot be reduced as much as would seem desirable. This could best be achieved by having the machinery in line as nearly as possible so that the drive is direct and does not involve a maze of countershafting. It would also be interesting to know whether alterations in the floor levels have any effect, and if a step is less conducive to noise than an inclined plane.

(4) The provision, where possible, of wooden pulleys and endless belts.

In conclusion, the parallel of industrial smoke may be cited. Twenty or more years ago smoke was considered inseparable from industry, and certain trite sayings proclaimed the fact, such as "Where there's money, there's muck." The position to-day is very different, and we look forward to an era of clean towns, free from the smoke pall. So, it is probable, will the problem of noise be tackled in the not very distant future.

Sheffield, August 29th. E. E. G. BRADBURY.

### HOURS OF WORK.

SIR,—I read with interest your editorial on the above subject, and it is a relief to see that the problem of "men *versus* machines" is at last beginning to interest those responsible for the machines.

When once a problem is correctly stated the solution should not be far to seek, but your conclusion that either we must reduce population or find a means to increase consumption contains, in my opinion, a fallacy, in that there is no alternative but the latter.

If we were faced with scarcity, reduction of population might be a way out, but our present embarrassment is due to surplus of goods and of means of production, which would only be accentuated by the reduction of population you suggest.

That the problem is one of consumption has for some time been known, and, in fact, the solution was published by C. H. Douglas as far back as 1923. The difficulty is merely now in applying the remedy in face of opposition from the supporters of the present financial scheme.

In your reference to the cost of unemployment as "25 millions per annum, which has to be found by industry," you touch on the only remedy, *i.e.*, the credits to finance consumption must come from the same source as those which financed the war ; they must be produced for the purpose on the real security of the desire of mankind to continue to live—that is, they would be "social credits."

London, August 29th. B. WOOD.

[Has our correspondent forgotten that each operative produces more than he himself can consume ?—ED. THE E.]

## A Large Electrically-Operated Excavator.

AT the Ipswich works of Ransomes and Rapier, Ltd., we recently inspected a large electrically operated excavator which has been built for use in the limestone quarry of the Bundi Portland Cement Company, Ltd. With a bucket capacity of 3–3½ cubic yards, the machine presents a very massive appearance, and, in spite of its heavy duty, it is easily controlled. The conditions under which machines of this kind operate are exceptionally arduous, and the stresses and strains arising from the very variable loads call for careful design and the use of the best operating equipment. The digging motion, for example, necessitates an almost instantaneous change in the pull from the very small one required to lift the empty bucket to the maximum pull the machine is designed to develop. Experience has shown that the variable speed-effort characteristic of the operating equipment must be independent of the skill of the operator; in other words, the driving equipment must give a high effort at low speeds and run fast at light loads on its own accord. An ungoverned steam engine, supplied with steam at constant pressure, gives the required characteristics, but owing to the uneconomical working of steam excavators, compared with electrically driven excavators, the makers of the machine under consideration have found that except in places where there is no electricity supply steam excavators are now rarely used.

The machine built for the Bundi Portland Cement Company is shown above, whilst Fig. 2 is a drawing giving a general idea of the design and lay-out of the operating equipment. In the construction steel castings have been largely used, and manganese steel has been employed for parts such as the bucket front, teeth, &c., that are subjected to the most arduous conditions. The only parts that are made of cast iron are the air cylinders for the brakes and clutch. All the operating machinery is enclosed in a double-roofed steel housing, equipped with fans capable of providing the amount of ventilation needed in India, whilst a separate and well-ventilated operator's cabin is provided at the front of the machine. By reason of their flexibility and the fact that they impose no restriction on the design of the boom as regards making it capable of taking the tangential forces, inside dipper sticks have been employed. The boom is composed entirely of steel and its working angle is adjustable.

The electrical equipment, which was supplied by the British Thomson-Houston Company, of Rugby, is a special form of Ward-Leonard equipment. Each motor in the system has its own generator, as shown in Fig. 3, with a special characteristic as represented by the curve

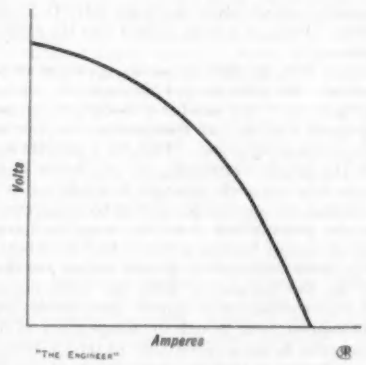



FIG. 1—GENERATOR CHARACTERISTIC

Fig. 1, the characteristic being obtained by suitably proportioning three field windings on the generator, namely, a separately excited shunt winding, a self- excited shunt winding, and a differential series winding. Combined with plain shunt wound motors, connected as shown, these generators give the desired results. Three generators and a squirrel-cage induction motor form a four-unit, four-bearing motor generator set, which is mounted at the rear of the excavator on a fabricated steel base plate supported on a three-point suspension arrangement, one point having a spring-mounted spherical seating. The induction motor, which is rated 200 horse-power at a speed of 1450 r.p.m., is supplied with 50-cycle current at 3300 volts, and is started by means of a remote push-button controlled auto-transformer starter, the time interval for starting being governed by a pendulum type time relay. On the high-tension oil switch overload and no-volt protective devices are provided. The high-tension current is led into the superstructure through oil-immersed collector gear combined with connecting plugs and sockets.

All the motors are ordinary shunt-wound machines. They are directly connected with the armatures of their

corresponding generators, but their field windings are separately excited from a 125-volt supply provided by a separately driven exciter. While the motor fields are permanently excited, matters are so arranged that when any motor controller is placed in the "off" position an "economy resistance" is connected in the field circuit, and it cuts down the field current to approximately 60 per cent. of its full value. Control of the various motions is obtained by varying the strength of the separately excited fields of the generators by means of three controllers, each with eight forward and reverse positions, giving eight characteristics in each direction.

Arrangements have been made for regenerative braking on all the motors with a view to reducing power consumption and wear on brake linings. Each motor is provided with an auxiliary blower, which can supply air to the machine irrespective of whether it is running or at rest. The hoist motor is flexibly coupled to a herringbone pinion, which meshes with a large diameter wheel connected to the main barrel through a friction clutch closed by air and released by a spring. The air supply to the clutch is controlled by an electrically operated valve excited *vid* a push-button in the driver's cabin. For normal digging operations the magnet valve is energised and the clutch is maintained in the "on" position, digging, hoisting, lowering and braking all being carried out with the clutch engaged. When digging the controller is pulled backwards as far as it will go and is returned to the "off" position when the bucket has been hoisted to the requisite height. The bucket is held in mid air by a brake which is air set and spring released, the air being controlled by a foot-operated, graduated valve arranged so that the pressure in the brake cylinder is approximately proportional to the depression of the foot pedal. When lowering the bucket the controller is moved to the full forward position and the motor helps to accelerate the movement of the drum and gears in the desired direction, whilst, at the same time, the lowering speed is limited to a safe speed by the motor. In order to bring the bucket to a standstill the controller is moved as rapidly as necessary to the full backward or hoisting position, or to any intermediate hoisting position if more gentle braking is required. The mechanical brake need only be used to hold the bucket in mid air.

For travelling the excavator the hoist motor is also used. The travelling motion is engaged by a sliding dog clutch, whilst the drum is freed by de-energising the clutch magnet valve, which releases the clutch. By means of selecting dog clutches either or both crawlers can be driven according to requirements. The motor for the rotating motion is coupled to a herringbone pinion running in an oil-filled gear case, which contains first and second reduction gears of the herringbone and plain types respectively. There is no clutch or mechanical brake associated with the rotating motion, the method of control being the same as that for the hoisting motion and all braking is done electrically. The crowd motion motor is coupled through a double-reduction gear to a rack and pinion, which moves the bucket arms in and out. A spring-set and air-released brake controlled by an electrically operated air valve works on the motor shaft extension and comes into action when the crowd controller is in the off position. This brake is always used for holding the bucket in the face during digging, but not for bringing the arms to rest after crowding in or out, for reversal of the controller under these conditions is a much more economical method of braking.

For the operation of the dipper trip a series wound torque motor is used which exerts a constant torque sufficient to take up any slack in the tripping cable, but not great enough to prevent the cable being paid out when required. For the purpose of limiting the current a resistance is connected in series with the motor, and when it is necessary to trip the door a contactor controlled by a latch-operated push-button on the crowd controller is made to short-circuit a portion of the resistance, with the result that the motor develops a torque sufficiently great to trip the door latch, which is reset during the lowering of the bucket.

The compressor is a single-stage, two-cylinder, water-cooled machine, capable of giving a pressure of 120 lb. per square inch, and a large reservoir used in conjunction with it gives an ample reserve of air and allows the compressor to be shut down during a large percentage of the working time. For driving the compressor an ordinary squirrel-cage motor is employed, and is started and stopped by a triple-pole contactor, the controlling push-button being in the operator's cabin. Thermal overload devices serve to protect the motor. The air pressure is maintained within the limits of 100/120 lb. per square inch by a pressure gauge with adjustable contacts, which determine the maximum and minimum pressures of the range. When the maximum pressure is reached the compressor shuts down and starts up again when the pressure falls to the minimum value. With a view to relieving the motor of heavy starting currents and sudden stopping the control is arranged so that the compressor is started up and shut down unloaded. The unloading is done by keeping the suction valves of the compressor open by small air pistons, and the duration of the unloaded period is controlled by dashpot time delay elements on the pressure control panel.

During our visit to the makers' works the operation of the excavator was demonstrated, and although it was not, of course, possible to imitate the conditions the machine will be called upon to meet in actual service, the way in which the equipment responded to the controls left nothing to be desired.

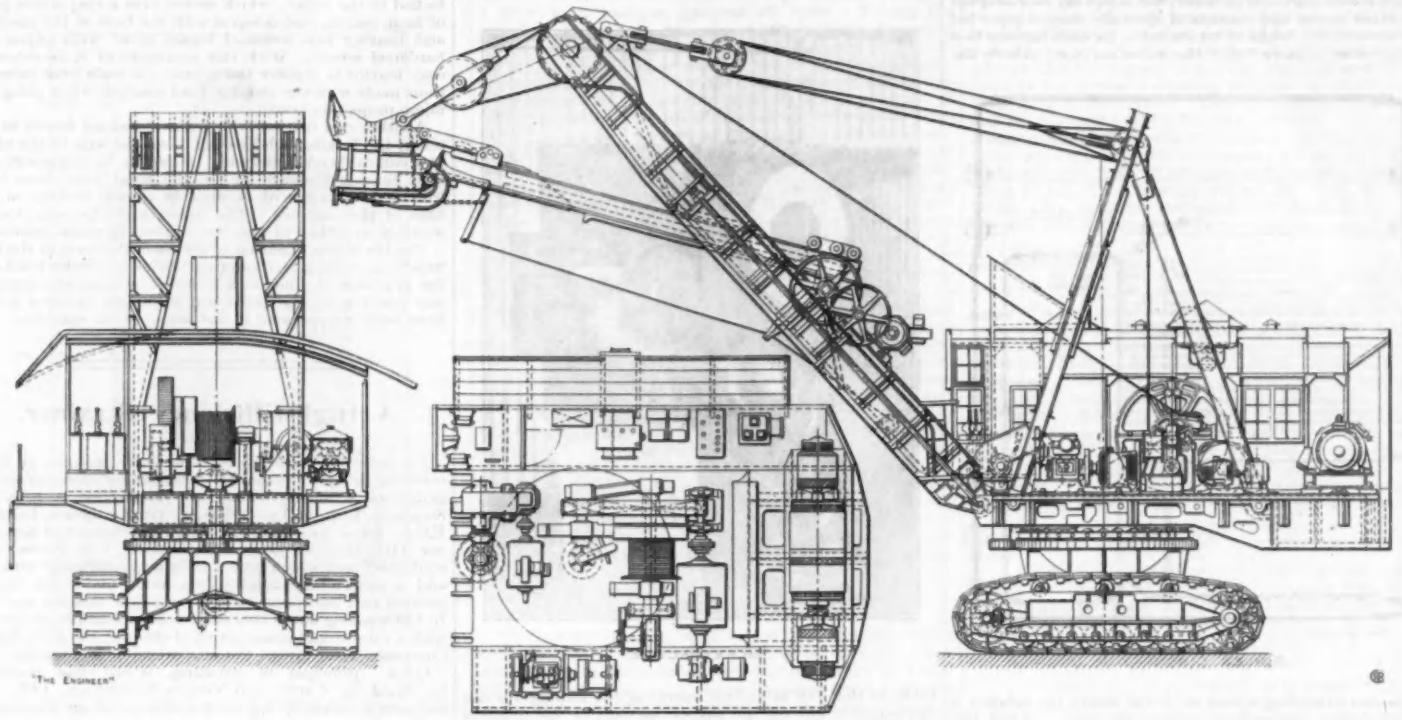



FIG. 2—DESIGN AND LAY-OUT OF OPERATING EQUIPMENT

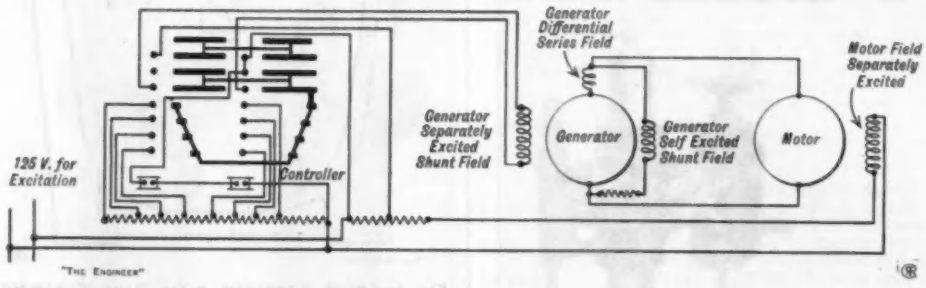



FIG. 3—CIRCUIT OF THE ELECTRICAL EQUIPMENT

The report by Colonel Trench on the collision of June 10th at Hammersmith, which document was briefly noted on page 183 of our issue of August 19th, shows the extreme care taken by the officers of the London Underground system to guard against even the slightest mishap. As is well known, all the running signals are provided with an automatic stop which is fixed by the side of the right-hand running rail. Its normal position is vertical and the change of the signal from "danger" to "clear" causes the stop to turn and to be nearly level with the top of the rail. On each motor coach is a trip which would engage with the stop were the latter in its vertical position, *i.e.*, should the signal be at "danger." In that event the actuation of the trip would cause the continuous brake to be applied and the train to be automatically pulled up. It may be added that should the stop be broken, or should it fail to resume its normal position after the train had passed, the signal next in the rear would be held at "danger."

To appreciate what happened at Hammersmith on the day in question it should be noted that for some days previously considerable alterations in the roads and signalling had been made in anticipation of the opening of the Western Extension. As was almost inevitable, there were several cases where train stops had failed to respond to their respective signals and trains had needlessly been "tripped." The motorman in question, under circumstances that need not be repeated, had had his train automatically pulled up deliberately and not as a result of any defect. The man, assuming that he had been "tripped" in error, alighted from his cab, reset the trip and proceeded, with the result that the collision followed.

There are, broadly, two classes of signals on the Underground—automatic and semi-automatic. The latter are those worked from signal-boxes, *e.g.*, at Hammersmith, and, on the District Railway, at Earls Court, South Kensington and Mansion House. These have the automatic feature that they assume the "danger" aspect when a train passes, independently of the signalman's action, but they cannot go to "clear" except by the movement of the allocated lever in the signal-box. Thus, these signals are partly, or semi, automatic. Automatic signals, on the other hand, have no such control, but are put to "danger" when a train passes and go to "clear" when that train has passed out of the section controlled by the signal.

Automatic signals, as will be understood from what has been said above, are for the protection of trains and for facilitating movements in, and between, stations where there is no signal-box. Thus, there are many in the tubes, and legislation is, therefore, necessary to avoid trains standing at such signals when the section ahead is actually unoccupied, but the signal, for some reason or other, has failed to change from the "danger" to the "clear" aspect. The instructions, in that event, are that the motorman, after standing at the signal for one minute, may proceed cautiously. But before the train can move the motorman must alight from his cab and move the trip clear of the automatic stop. When, however, a semi-automatic signal, which, as said above, has the mind of the signalman behind it, fails, no movement must be made without that man's permission. He, moreover, must consult the stationmaster before taking any action as to allowing the train to proceed, and that officer must satisfy himself that the section in advance is unoccupied and that all the points over which the train has to travel are in their proper position. How rigidly this rule is observed can be appreciated from Colonel Trench's remark that he was informed that, with the exception of a solitary case on the District Railway some years ago, the railway company had no previous record of a trip having been reset at a semi-automatic signal, except in accordance with the rule, and none of the witnesses had ever heard of a case when that had been done.

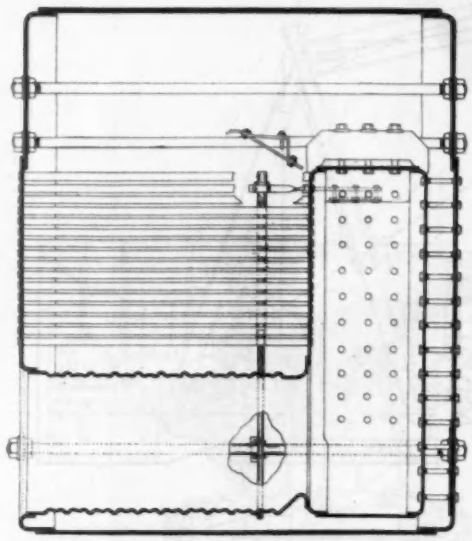
## Safety on Tube Railways.

THE trains on the tube railways of London travel nearly 18 million miles a year and carry nearly 330 million passengers, exclusive of season ticket holders. The safety of their movement, is, therefore, a very important one.

THE province of Cordoba, Argentina, is proposing to construct 5000 kiloms. of roads during the next five years.

## The "Templex" Circulator.

ONE of the greatest problems in boiler work is that of ensuring adequate circulation of the water. Poor circulation results in comparatively large temperature differences between the various parts of the structure, and the consequent strains cause leakage at riveted seams, encourage corrosion, and set up deterioration of the boiler plates. The device illustrated by the accompanying line engraving is made by Lionel Le Sueur and Co., Ltd., of 11, St. Mary Axe, London, and is designed to overcome these defects by causing positive circulation. It is shown fitted to a single-ended marine type boiler, but is equally well adapted for other types, and consists of specially shaped pipes led up between the banks of return tubes for each furnace to a point some distance below the water surface. Above the

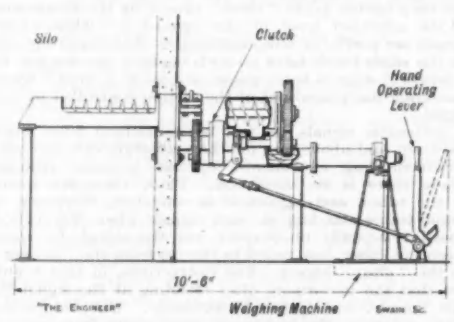



BOILER CIRCULATOR

pipes and extending across the boiler above the tubes is a baffle sloping downwards towards the back. When the fires are first lit the top portion of each of the circulation pipes, which form a temperature balance, gets hot very quickly, while the water below remains cool. Consequently the water in the upper part flows upwards and cooler water rises from below to take its place. In this way circulation of the water before the generation of steam has started is caused. When steam has been raised the temperature balance goes out of operation and the baffle becomes responsible for circulation. The steam bubbles burst beneath the baffle. The steam and water are forced sideways and circulation of the water is thus brought about. The makers claim that by the fitting of this device the steaming capacity of a boiler may be raised by 5 to 8 per cent. or the fuel consumption reduced by 5 per cent. The device may be fitted to an existing boiler without the necessity for drilling holes, and many are already in use, both afloat and ashore.

## The Stag Silextractor.

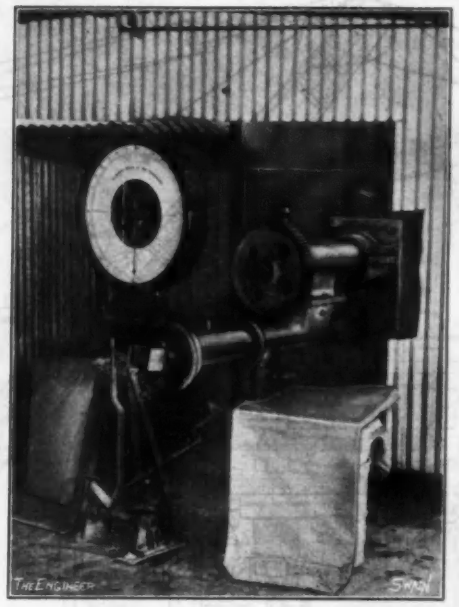
THE machine illustrated by the accompanying line and tone engravings has been produced by Edgar Allen and Co., Ltd., of Sheffield, as a simple apparatus for extracting such materials as cement and other powdered or granular




SECTION THROUGH SILEXTRACTOR

substances from silos or other containers in which the material is stored. It is adapted to deliver the substance directly into bags.

The packer consists of a cylindrical conveyor tube which is carried out of the bottom or side of a silo in which the material is stored, and in this tube is a conveyor worm, by means of which material is extracted and conveyed along the tube. The outer end is provided on the underside with an opening which leads into the inner end of a second conveyor tube of smaller diameter, which is disposed below the main tube. This secondary conveyor tube extends beyond the main tube, and the diameter at its outer end is gradually reduced to form a spout, which is adapted to deliver the material into bags. The packer is arranged so that the bags, during the filling process, rest on the platform of a weighing machine, in order that the required weight of material may be delivered into the bag. The secondary conveyor tube mentioned above is similar to the main conveyor tube, in that it lies in a horizontal position and is fitted with a conveyor worm, the shaft of which is carried out through a bearing at the end. As the diameter of the secondary conveyor tube is much less than that of the main conveyor tube, it is, of course, necessary to drive the worm in the former at a higher speed than that in the latter. The gearing to be seen in the illustrations is arranged to drive the worm in the secondary conveyor tube at such a speed relatively to the worm in the main conveyor tube that both are adapted to deal with the same amount of material, and both tubes being horizontal, the delivery is cut off immediately the conveyor worms cease rotating. The lever for controlling the clutch in connection with the pulley on the main driving shaft is placed near the delivery end of the secondary conveyor



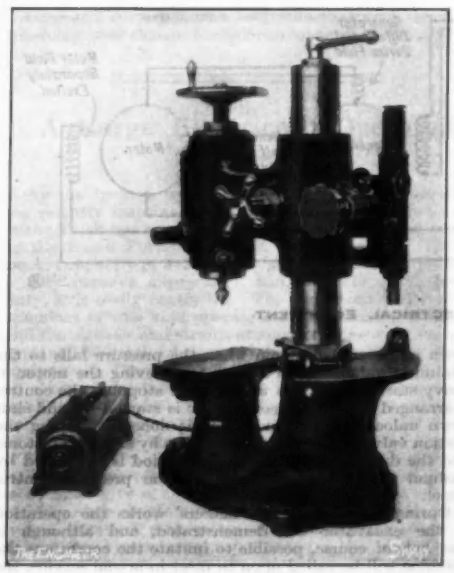

SILEXTRACTOR

tube, so that the attendant operating the silextractor can conveniently cut off the supply as soon as the required weight of material is delivered into the bag fitted on to the spout, and can start it again as soon as the full bag has been replaced by an empty one.

This device can be fitted easily to existing silos of different forms. It is claimed that after a little practice bags can be filled with the correct weight of material with only a small percentage error, so that check weighing becomes unnecessary. Very little dust, it is stated, is present during the packing operation, so that the operator works in comparative comfort.

## The Firth "Hardometer" Hardness Testing Machine.

THE Firth "Hardometer," made by Thos. Firth and John Brown, Ltd., has been remodelled by introducing features which experience has proved to be desirable. The latest type is shown in the accompanying illustration.



HARDOMETER

A feature of the "Hardometer" has always been the facility with which the scale of the measuring microscope can be accurately aligned over the indentation on the specimen. With the recent introduction of the patented high magnification micro projection head it became a matter of importance that this alignment should be made with extreme precision, with absence of complicated detail and without impairing in any way the simplicity and speed of handling associated with the earlier design of machine. In the earlier type of "Hardometer" the terminal points of the arc of swing of the microscope were determined by the contact of the ends of a segmental groove cut round the periphery of the lower end of the revolving pillar with the projecting ends of two adjustable set screws suitably positioned in the base casting, and the available length of this arc was, naturally, rather limited, being governed, of course, by the available diameter of the pillar. It will be appreciated that the larger the radius on which the terminal contact points operate the more accurate the requisite alignment will be. This principle has been followed in the present design, a considerable increase in the diameter at which the contacts operate having been secured by the provision of an extension arm—securely locked to the pillar—which moves over a rear sector plate of large radius, cast integral with the base of the machine and bearing two terminal bosses fitted with adjustable hardened screws. With this arrangement it becomes an easy matter to register the microscope scale over indentations made with the 10 kilos. load machine when using the micro projection head.

Another new feature is the central locking device of the pillar, the locking bolt passing down the axis of the pillar to a conical-headed nut which is drawn, by comparatively light turning pressure on the top hand lever, into hard frictional contact with a suitable conical seating in the base of the machine. The pillar is in this way locked securely at either of the two desired terminal positions.

The three-point bearing of the base, the form of the star handle for raising and lowering the load cylinder head and the provision of a one-lock lever for securing the latter at any position on the pillar are additional features which have been incorporated in the design of the machine.

## A High-Efficiency Strainer.

ON more than one occasion we have referred in these columns to the patented self-cleaning non-collapsible gaugeless strainers which are made by Auto-Klean Strainers, Ltd., of Tower House, Trinity-square, London, E.C.3. In our Olympia Exhibition Supplement of September 11th last, we described the new Auto-Klean self-contained unit which embodies a multi-cartridge strainer and a semi-rotary hand pump, built under the Seeley patents and incorporating a reverse flow cleaning system. In the working out of this reverse flow principle, combined with a wire-wound construction of strainer, the Auto-Klean Company was given the opportunity of testing the "Lolos" principle of straining, which was invented by Mr. John Wardle and Vickers-Armstrongs, Ltd., and has been successfully applied for both naval and mercantile




FIG. 1—LOLOS STRAINER WITH PUMP CLEANING

marine work. In view of the simplicity of the "Lolos" design, and the availability of a wider range of possible materials which are able to withstand very corrosive liquids and gases, the Auto-Klean Company decided to acquire the exclusive British rights of manufacture and sale from the proprietors, Vickers-Armstrongs, Ltd., and the "Lolos" strainer can now be supplied by the Auto-Klean Company for work in which it can be used to the best advantage. The Auto-Klean strainer, it may be recalled, consists of a number of thin plates pierced in the form of a spoked wheel, which are mounted upon a central spindle with between each pair of plates a cleaning blade threaded on a fixed rod. The self-cleaning straining cartridges thus formed can be mounted either singly or in groups in appropriate casings. In the "Lolos" strainer, so named on account of the low losses in pressure and the resulting high efficiency, the straining cartridge is formed by winding wire on to the surface of a threaded cage built up of extruded bars. The fineness of straining is controlled by the diameter of the wire used and the number of turns per inch; strainers with half a thousandth of an inch between adjacent wires are made. The makers claim that the round section of the wire forms virtually a Venturi orifice between each adjacent pair of wires, giving the low pressure losses which are experienced with this type of strainer. The simplest form of strainer used

for petrol and oil engine fuel and lubricating systems and similar services, where facilities for occasional removal and cleaning are at hand, consists of a plain wire-wound cage which is housed in a casing shown in section in Fig. 2. The flow of the oil is indicated by the arrows. When it is desired to take out the cage it is only necessary to remove the top cap nut. For continuous service either mechanical cleaning or reverse flow cleaning should be employed. For mechanical cleaning the cage is made to rotate against a fixed pack of six toothed pinion-shaped plates, which rotate on their spindle and are interleaved with spacing washers, so that the teeth engage the spaces between adjacent wires and force out any solid matter or sludge which has accumulated in the slots. The sludge is swept

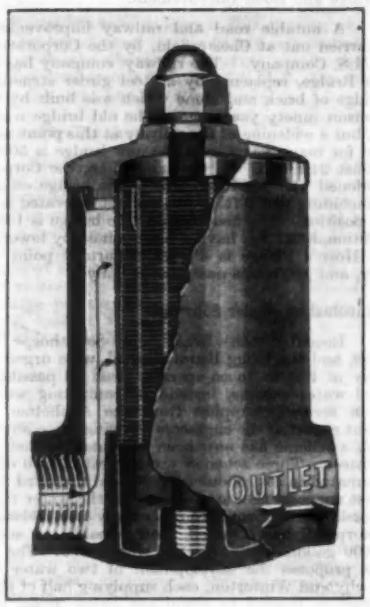



FIG. 2—LOLOS WIREWOUND STRAINER

off by a vertical knife, which localises the lifted sludge and deposits it in a large sump chamber.

In Figs. 1 and 3 we illustrate two forms of "Lolos" strainer with reverse flow cleaning. Fig. 3 shows a type used for the smaller sizes in which cleaning is effected by forcing cleaned fluid through the straining wires in a reverse direction, this being accomplished by a double-acting plunger actuated by a quick-motion thread. The operating handle passes through a packed gland. For the larger types of strainer a different form is used, which is illustrated in Fig. 1. In this case the reverse flow is obtained by a semi-rotary vane pump within the cage; a similar arrangement of scraper and sludge sump to that already referred to is used. For very large capacity strainers, for lubricating oil and similar services, multiple cartridge designs are available. In these types provision

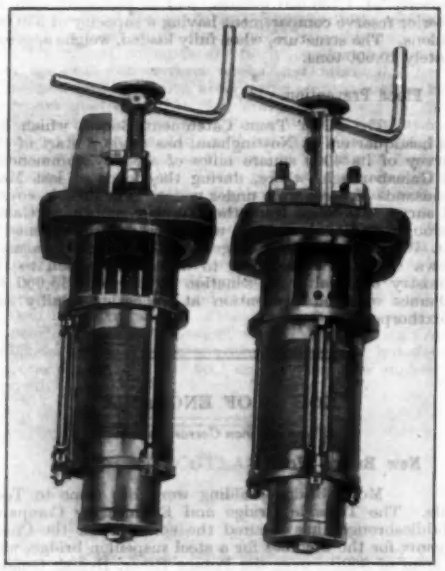


FIG. 3—LOLOS STRAINER WITH PLUNGER CLEANING

is always made for a continuous flow of liquid from the inlet to the outlet branch of the casing, the cleaning being carried out sectionally in such a manner that the stripped-off dirt is deposited in the lower portion of the sump, where it can lie undisturbed by the incoming flow.

THE INSTITUTE OF MARINE ENGINEERS.—Admission to the Student Section of the Institute of Marine Engineers is obtained by examination. Arrangements are now being made to hold the next examination in April, 1933, at various centres according to the candidates' places of residence. Full particulars and copies of previous examination papers may be obtained on application to the Secretary, the Institute of Marine Engineers, The Minories, London, E.C.3.

# Provincial Letters.

## THE MIDLANDS AND STAFFORDSHIRE.

*(From our own Correspondent.)*

### Forward Movement.

VERY gradually the industrial position in the Midlands and Staffordshire improves. Week by week the outlook becomes brighter and increased activity is noticeable in different branches of trade. Unfortunately, it is not always possible to uphold the improvement and after a short spell business slackens off again. Taking the situation as a whole, however, work is slowly becoming better and activity more sustained. Another good feature is that to a qualified extent the raw material and heavy engineering industries are sharing in the advance, and with the advent of autumn there is every prospect of further progress. Additional inquiries for supplies were in circulation on 'Change in Birmingham this week, and in quite a number of instances they related to larger tonnages than is necessary to satisfy customers' current requirements. Users are perhaps about to replenish exhausted stocks. At the Black Country works, except where foreign raw material is much used, stocks are almost non-existent, and it is possible some firms consider it advisable at this stage to build up some reserves. Whether this is the case or whether manufacturers are banking upon a larger output over the next month or so cannot be determined, but whichever may be the case, iron and steel masters welcome the improved inquiries and they believe many of them will develop into actual orders in the near future. Productive plant is in such excellent condition that Midland producers will be able to respond without difficulty to all the calls likely to be made upon them, and in most instances stocks at the mills are sufficient to supply any urgent orders. A little more cheerfulness exists in industrial circles here, and it is believed that the Ottawa agreements will prove to be all to the good of Midland trade. Most things now appear to be moving in the right direction, and the autumn of 1932 may well mark the end of a period of depression and the commencement of a real and lasting revival. Such is the hope expressed by industrialists here and such is the belief of a goodly proportion of them.

### Steel.

Steel masters appreciated the slightly better demand this week for billets and small re-rolled bars. Business since the holiday week has been very poor and mills were becoming short of specifications when this week orders began to come along again, and consumers expressed the opinion that they would require more material in September than they did during the preceding month. It is noticeable that the improvement coincides with an increase in price of Continental competing products, values of which have advanced in the case of billets by from 1s. to 1s. 3d. per ton and in the case of steel bars by from 4s. to 5s. per ton during the past couple of weeks. It is held that this is in no way responsible for the change in the position, Continental material prices being still well, below those of native makers. An improved consumptive demand is considered to be the cause. If foreign selling prices advance further, however, there may be some transference of business to home producers, and for this reason the course of Belgian, French, and German quotations is being closely followed. While English mild steel billets are maintained at £4 17s. 6d. to £5 7s. 6d., according to the quantities taken, foreign material has advanced to £4 10s. Native small re-rolled steel bars are firm at £6 7s. 6d., but Continental bars are up to £5 3s. to £5 4s. per ton delivered. Staffordshire re-rollers demand the full £7 per ton for all-British bars. Sheet bars cost £4 15s. upwards. The demand for finished steel is not noticeably improved, the consuming industries lacking activity. Though the outlook in some of the engineering trades is becoming clearer, business has not as yet developed more rapid momentum and works are engaged at about the same capacity as before the holiday break. Material selling prices are firmly held at the basis fixed by the Steelmasters' Association. Angles are quoted £8 7s. 6d.; joists, £8 15s.; and ship, bridge and tank plates, £8 17s. 6d., subject to rebate to users of British steel only. Boiler plates make £8 7s. 6d. to £8 10s.

### Manufactured Iron.

The position in the Staffordshire finished iron industry is unchanged on the week. There is little relief to the dull conditions which have prevailed for some time past, though a few orders are being booked for September and October delivery. Makers of marked bars are receiving a steady flow of small orders, though the mills are running on a week-to-week basis only. These mills are rather better off for work than those devoted to medium and lower grades of iron, which have to contend with severe internal and foreign competition. The long-standing quotation of £12 for best-grade bars is unchanged. Crown bar makers are in most cases unable to keep their mills in regular employment and there is little to justify expectations of an early improvement. Supplies are offered by competing districts at prices below those acceptable to Staffordshire houses. The latter range from £9 to £9 15s., while other districts accept down to £8 12s. 6d. There is only a very restricted market for common bars, imported iron being obtainable at very low prices. The rates remain at £7 15s. to £8 5s., compared with £5 17s. 6d. to £6 2s. 6d. for Continental iron delivered Black Country stations and including duty. There is but a moderate demand for iron tube strip and values are none too firm. Sales take place at from £10 7s. 6d. to £10 10s., but users are endeavouring to get more favourable terms for themselves. Mills badly in need of work have difficulty in upholding their quotations.

### Raw Iron Prices.

The Midland Pig Iron Producers' Association has again this month reaffirmed the current basis of selling prices. These rates have existed since April of last year, and the decision to make no change for the opening of the autumn season is considered by users to be commendable, especially as there is evidence—as noted in this letter last week—of an improvement in demand. This, it is thought, might easily have been nipped in the bud by an advance in purchasing rates. The steadiness of material prices should encourage users to look and purchase ahead, and blast-furnacemen are expecting an extension of the return to the old policy of forward buying. Their relations with users are cordial and in contrast with what they were when the latter embarked upon their policy of hand-to-mouth buying, so that the time should be opportune for a resumption of the old terms of business. Foundrymen, naturally, desire to be able to see some distance ahead before they commit themselves to any great extent, but there are indications that as soon as they are in a position to do so they will place long-date contracts with Midland blast-furnacemen. At date demand for foundry material is fitful and not up to expectations, while there is a very poor call for forge grade iron. The seasonal trade in light castings for domestic heating purposes is rather late in developing to any extent. There is obvious movement in this branch in the Black Country, however. The scale of selling prices reaffirmed is as follows:—Northamptonshire forge, £2 17s. 6d.; No. 1 foundry, £3 5s. 6d.; No. 2, £3 4s. 6d.; No. 3, £3 2s. 6d.; No. 4, £3 1s. 6d.; Derbyshire forge, £3 1s.; No. 1 foundry, £3 9s.; No. 2, £3 8s.; No. 3, £3 6s.; No. 4, £3 5s., delivered at stations in the Black Country and subject to rebate.

### Galvanised Sheets.

Galvanised sheet makers have this past week received a number of orders from the home market which have helped to swell their order books and place them in a relatively better position. The call from overseas has not advanced further and the stirring of home demand is welcomed. Even if it gains considerable added weight, however, it cannot be expected to anything like compensate for the falling-off of export sales. While 24-gauge galvanised corrugated sheets continue to be quoted £9 2s. 6d. to £9 5s. per ton for shipment abroad, for home business some local mills say they are able to obtain £9 7s. 6d. per ton. There is a growing consumption of black sheets, sales of which are made at recent ruling rates.

### Orders for Boilers.

W. G. Bagnall, Ltd. of Stafford, has received orders for locomotive boilers as follows:—Ten for the Eastern Bengal State Railway, and nine for the North-Western Railway, India.

### Electrical Equipment.

The electrical equipment for fourteen "Leyland-G.E.C." four-wheel double-deck trackless trolley omnibuses is to be manufactured by the General Electric Company, Ltd., of Witton Works, Birmingham.

### Steel Fish-bolts.

Bayliss, Jones and Bayliss, Ltd., of Wolverhampton, are tendering for the supply to the Liverpool tramways of 8 tons of steel fish-bolts, complete with nuts and washers, and the responsible Committee recommends the acceptance of their tender. This firm has recently received a large order for railway material, which, it is expected, will cause the reopening of a department and the employment of additional hands.

## LANCASHIRE.

*(From our own Correspondents.)*

MANCHESTER.

### Russian Work for Engineers.

INTERESTING information bearing on the Russian trade situation from the point of view of Lancashire engineering firms and in relation to the policy of the Export Credits Guarantees Department, was given by Mr. R. Greenwood, managing director of Craven Brothers (Manchester), Ltd., machine tool manufacturers, of Vauxhall Works, Reddish, near Manchester, in a statement this week. Just short of a year ago the firm secured contracts from Russia of a total value of £423,000. The work, which is now reaching the completion stage, has provided employment during the twelve months for between 700 and 800 additional employees. The past few months, however, have witnessed the discharge of a number of workpeople who were engaged in the drawing-office, pattern shops and other departments. Work is still being actively carried on in the fitting shops and is likely to be during the next two or three months; but beyond then the outlook is obscure. Apart from Russia, the prospect of orders from abroad is not bright, and in the absence of any important development reliance will have to be mainly upon the home market. In these circumstances a heavy reduction in the number of workpeople employed by the firm would appear to be inevitable.

### More Orders Within Reach.

Further important contracts for the Russian market are already available, but whether they can be accepted or not seems to be dependent entirely upon the attitude of the Export Credits Department. Is it within the range of practical finance and, presumably, of politics, for the period of credit to be extended from twelve months, which the Department is understood to be prepared to consider, to eighteen months, which appears to fit in better with Russia's plans? Subject to arrangements being made for the latter period, a further contract which would keep all the departments at the Vauxhall Works fully occupied for three months and would take six months to complete has just been signed by Mr. Greenwood. The provision of adequate credit arrangements would, Mr. Greenwood asserts, place within easy reach of the company work which would keep the firm's plant running actively for rather more than two years. It has been the experience that payments due from Russia for work done have been punctually made, and in this respect the experience of many other engineering concerns in the district is borne out.

### A 200-ton Milling Machine for Japan.

A 200-ton milling machine, one of the largest of its kind in the world, is to be delivered by Kendall and Gent (1920), Ltd., of Victoria Works, Gorton, Manchester, to the Japanese Navy for use on shipbuilding and heavy engineering work. The electrical part of the machine, the cost of which is between £15,000 and £16,000, has been supplied by the Metropolitan-Vickers Electrical Company, Ltd., of Trafford Park, Manchester.

### Building Trades' Scholarship.

In connection with the degree course for building which has been introduced into the syllabus of the Manchester College of Technology, it has been decided by the North-Western Federation of Building Trade Employers to award a three years' scholarship for building which will be tenable at the College.

### Non-ferrous Metals.

Generally strong non-ferrous markets have again been witnessed during the past week, and prices have registered appreciable advances in all sections, with tin, after a relatively uneventful spell a week ago, resuming its upward movement in no uncertain manner. Much of the heavy turnover in the copper section since last report has been speculative in character, although the demand from consumers appears to have been somewhat more pronounced. Standard brands of the metal are nearly £2 10s. per ton dearer at the moment of writing than they were a week ago, and the tone of the market continues firm. The statistical position in the tin section seems to be displaying some indication of improvement, and it is this factor, rather than any appreciable expansion of the demand, which accounts for the rise on the week of about £6 per ton. Sales of lead to industrial users of the metal in the United States have increased a little and a shade more interest has been shown on this side also. The price position in this section is very strong at the moment and values have moved up since last report to the extent of about £1 5s. per ton. Spelter is roughly 10s. per ton dearer and better sales, coupled with some reduction of the volume of supplies, have served to maintain the recent firmness of the metal.

### Iron and Steel.

On the iron and steel markets here this week complaints were already heard of the harmful effects on the consuming industries of the cotton trade strike which started last week-end. This, of course, is more especially the case in the cotton towns themselves, the iron and steel users in Manchester being less directly affected. Fresh business in foundry iron has been on a limited scale, and strike and seasonal influences between them have served to reduce the movement of iron into consumption, with the heavy supplies of machinery scrap a further restrictive factor. Quotations, however, keep up on the basis of 67s. per ton for Staffordshire, Derbyshire and Cleveland No. 3, 65s. 6d. for Northants, 62s. for Derbyshire forge, about 85s. for Scottish foundry, 81s. for West Coast hematite, and from 67s. to 75s. per ton, according to quality, for Indian iron, all for delivery Manchester or equal distance. Bar iron prices are maintained, but only a quiet business is being done. Lancashire Crown quality material is quoted at £9 15s. per ton and best bars at £10 5s. There has been no improvement in the steel section, and the usual slow demand is being experienced, although there has been a little more inquiry about this week for boiler plates. Interest in special alloy steels and also in forgings is reported to have fallen off in consequence of the cotton mill stoppage. The controlled products continue firm on the basis of £8 7s. 6d. for sections, £8 15s. for joists, £8 17s. 6d. for ship and tank plates, £9 2s. 6d. for frame plates, and £9 7s. 6d. for large diameter bars. Offers of small re-rolled bars are easy in tendency, and whilst from £6 15s. to £7 per ton is the nominal range of prices, lower rates are being indicated where a moderate tonnage is at stake.

BARROW-IN-FURNESS.

### Hematite.

There is very little fresh to report on the hematite pig iron market in this district. Orders are only small yet, and buyers are confining them to immediate requirements. When this month is out there may be an improvement in the demand, as August is always a slack month. Stocks remain heavy despite the fact that there are not many furnaces in blast. It is not known when Barrow will restart its two furnaces, but there are rumours that it will not be long before they begin producing iron again. Shipments have been light and are confined to home ports. Continental and American business has not livened up yet. The iron ore trade continues to be quiet, and at some of the mines there is plenty of ore on the surface awaiting buyers. Foreign ore is in very restricted demand; the steel trade is quiet and the rail mills at Barrow are still idle, but it is possible that they may restart shortly. The hoop mills have orders which they are executing and the small section mills are engaged.

### Shipbuilding.

On Tuesday, Vickers-Armstrongs, Ltd., launched the submarine "Porpoise" for the British Navy, and at the after proceedings it was announced that the firm had received the contract for building the first-class cruiser "Ajax." This represents two and a-half years' work at Barrow for 2500 men.

## SHEFFIELD.

*(From our own Correspondent.)*

### The General Position.

CONDITIONS in the local steel trades show little change from what has recently been reported. Taken on the whole, the various branches are about maintaining their ground, and the bulk of the workpeople who were suspended from the August holidays have resumed. Manufacturers are not lacking in confidence for the future, as there are indications of revival, though not an immediate one. The plants producing open-hearth steel are still employed at something less than half capacity, but, even on this level, their output is considerable. It is still found difficult to obtain orders for bulk quantities, or for forward delivery, most of the business placed being of a hand-to-mouth character. There is much shortage of work in the heavy manufacturing departments, and the shops devoted to shipbuilding and railway requisites are, in particular, poorly employed. It is feared that the recent pact between the L.M.S. and L.N.E. railway companies will curtail the demand for railway material. Many engines are being put out of commission, and less rolling stock will be required to deal with the traffic of the two companies. A proposal for the breaking up of our many obsolete merchant ships is attracting the interest of scrap merchants.

### The Lighter Side.

On this side, several branches are able to give a fairly satisfactory account of themselves. The automobile trade is a good customer for Sheffield goods, including stampings and pressings, and special steel, although, as its new season's demands have not yet developed, the volume of trade is hardly up to the average. The demand for cold-rolled strip, and best wire, is well sustained. Stainless steel and kindred materials continue to be one of the most progressive branches of local industry. The prevailing depression has had its effect here as well as elsewhere, but loss of tonnage through this cause is balanced by the continual introduction of new applications. Stainless Steel Goods, Ltd., of Sheffield, has just received an interesting inquiry from one of the big railway companies relating to the metal fittings of fifty carriages at present under construction. The samples number seventy-three, and include door handles and guards (at present made of brass), and the brackets of luggage racks. It is hoped that good business may result from the inquiry. All the parts can be made up from steel manufactured in Sheffield. It is interesting to read that the Ford Motor Company has achieved complete success with an experiment in producing car lamps from rustless steel. At the company's works, eighteen headlamps are stamped every minute on an automatic progressive press, which performs eight operations. It is reported that the company has proved that rustless steel can be used for the purpose at only a slight additional cost as compared with carbon steel which is chromium-plated to produce a bright lustre.

### Goole Dock Improvements.

Considerable extensions of the facilities provided at the West Dock at Goole have recently been completed by the L.M.S. Railway Company, by arrangement with the Aire and Calder Navigation, which owns the docks. A large shed, sidings, and cranes, have been provided at the north side of the dock, and these, with other accommodation used by the railway company, will permit of a distinct demarcation between the import and export sides of their shipping business carried by the Goole Steam Shipping Services. Closer concentration will thus be effected, which will enable the work to be performed expeditiously. The new shed is 502ft. long by 75ft. wide. Four sidings, each approximately 560ft. long, are laid at the back of the shed, two of them being under cover, and in the centre of them there is an electrical traverser passing over all the four lines of rail. There are also two sidings, approximately 1040ft. long, laid on the quayside in front of the shed. The shed is equipped with six longitudinal electric travelling cranes, five of them of 30 cwt. and one of 5 tons, each with a span of 70ft. 7in. The side of the shed nearest the quay is fitted with roller shutter doors, which enable the whole front to be opened out as required when cargoes are being discharged from or loaded on to ships. On the quayside there are eight 3-ton portal electric level luffing cranes with a minimum and maximum rake of 20ft. and 53ft. respectively. These cranes can deal with 3 tons at a speed of 180ft. per minute, and, being operated by D.C. motors, lighter loads can be lifted correspondingly faster. The slewing speed is 400ft. per minute at the jib head, and the luffing speed 150ft. per minute. The luffing device of these cranes is of a simple type, which involves only one hoist rope at the jib head. On the quay and sidings there are fixed fifteen electric capstans to facilitate the movement of wagons. The accommodation provides for three shipping discharging berths, two of which are for miscellaneous goods carried by the company's Goole Steam Shipping Continental services, at the west end of the quay, and at the east end there is an open berth for general use of vessels requiring to discharge bulk cargoes direct to rail. Cranes are provided at each berth, and grab discharge is available as required.

### Hull's New Waterworks.

Some further details are now available of the new reservoir which Hull Corporation is proposing to construct at Farndale, in North Yorkshire. The reservoir will be 2 miles long and half a mile wide, and the area to be flooded will be 480 acres, though it is probable that in all 1000 acres will be required. Mr. Edgar Morton, a consulting geologist, whose opinion has been taken by the Corporation, has answered a criticism that the strata of Farndale valley is limestone, and, therefore, pervious. He says that "the geological strata forming the site of the proposed reservoir consist entirely of the shales of the lower lias series, which may be regarded as one of the most impervious geological formations in the country, and equivalent in this respect to the shales upon which many of the Pennine reservoirs are founded. The thickness and extent of these impervious shale beds in Farndale are such that the whole of the basin of the proposed reservoir will rest thereon. The nearest point at which pervious limestone occurs is on the river Dove, near Kirby Moorside, about 8 miles away."

### Mechanical Coaling Plant.

The L.M.S. Railway Company has installed, at Toton, near Nottingham, a new plant for mechanical coaling of locomotives, which is one of the largest of its kind in the country. It has a bunker over 70ft. high and 35ft. square, capable of dealing with 3000 tons of coal a week. Toton is an important locomotive depôt dealing principally with the coal traffic from the Nottinghamshire and Derbyshire coalfields to London. Coal wagons of up to 20 tons capacity are lifted by a hoist to the top of the plant and the coal tipped into a bunker from which locomotives are coaled in a few minutes, this method being much more rapid and economical than the old one of coaling by hand. There are now eighteen of these installations in various parts of the system. Mechanical ash-lifting plants have also been installed, by means of which the ashes from locomotives are lifted from the ash pits after they have been quenched with water.

### Bridge and Road Improvement.

A notable road and railway improvement has been carried out at Chesterfield, by the Corporation and the L.M.S. Company. The railway company has rebuilt Horn's Bridge, replacing by a steel girder structure the old bridge of brick and stone which was built by George Stephenson ninety years ago. The old bridge was quite sound, but a widening of the railway at this point has been wanted for many years, and the new bridge is 50ft. wide as against 24ft. 4in. At the same time, the Corporation has widened the roadway, which the bridge crosses, to 50ft., including two 10ft. footpaths in an elevated and protected position. The headroom of the bridge is 15ft. 6in., an additional 2ft. 6in. having been gained by lowering the road. Horn's Bridge is a very important point on the railway, and 400 trains pass over it daily.

### Lincolnshire Water Schemes.

Recently the Brigg and Scunthorpe Urban Councils, and the Brigg Rural Council, were urged by the Ministry of Health to co-operate, if at all possible, in a regional water scheme, instead of competing with each other in securing supplies from the Ancholme valley. The joint report of the engineers advising these authorities on such a scheme has now been presented to their Water Committees. Three schemes are suggested, two of which are estimated to cost about £60,000, and the third £47,000. The first suggests the development of the water resources at Wressle Farm, Broughton, a supply now belonging to Scunthorpe Urban Council, and capable of supplying 1,000,000 gallons daily, for the whole area. The second scheme proposes the development of two water sources at Scawby and Winterton, each supplying half of the area. The third is limited to supplying Brigg urban district, and parts of Brigg rural district, excluding Scunthorpe, and yielding only 300,000 gallons per day, the assumption, doubtless, being that Scunthorpe will develop its present undertaking and supply the remaining parts of the Rural Council's area. The net cost of producing water from the three sources is 8·46d. in the first scheme, 8·65d. in the second, and 10·13d. in the third. In view of the estimated cost, it is considered doubtful whether the Scunthorpe Council will agree to any of the three schemes. The chairman of the Scunthorpe Water Committee has intimated the possibility of a fourth scheme, which would be cheaper than any of the others.

### Heanor's New Storage Reservoir.

Heanor Urban Council has completed a large storage reservoir at Codnor. It is of reinforced concrete construction, of cylindrical form, with a mean internal diameter of 101ft. 6in., and a mean water depth of 26ft. 3in., and is probably the largest reservoir in this country of its particular type and depth. It has a holding capacity of 1,330,000 gallons, and is provided with an interior reserve compartment having a capacity of 330,000 gallons. The structure, when fully loaded, weighs approximately 10,000 tons.

### Flood Prevention.

The River Trent Catchment Board, which has its headquarters at Nottingham, has made a start of the survey of its 4000 square miles of area by commencing at Gainsborough, where, during the floods of last May, thousands of acres were under water. The area in course of survey stretches from the Humber mouth to Gainsborough, and six engineers, under the superintendence of Mr. W. H. Haile, are engaged on the work. Doncaster Town Council has resolved to make application to the Ministry of Health for sanction to borrow £15,000 for schemes of flood prevention at Wheatley, Balby and Hexthorpe.

## NORTH OF ENGLAND.

*(From our own Correspondent.)*

### New Bridge Work.

MORE bridge building work has come to Teesside. The Teesside Bridge and Engineering Company, Middlesbrough, has secured the contract for the Crown Agents for the Colonies for a steel suspenion bridge, with a span of 360ft., over the Potara River, British Guiana, and from the High Commissioner of South Africa an order for two spans, each 160ft. long, to form a bridge over the Tugela River. The firm is also to build a large car shed, 448ft. by 200ft., and a cleaning shed, 448ft. by 100ft., for the Cockfosters depôt of the London Electric Railway. The whole of the steel for these orders, amounting to 1000 tons, will be manufactured in the Teesside district, and though this work will not mean any additional hands being employed at the Teesside Bridge Works, yet it will ensure work until the end of the year for those already engaged.

### Cleveland Iron Trade.

Prospects of increased activity in the Cleveland pig iron trade are becoming brighter. There has been a welcome improvement in the tone of the market this week. After a lengthy period of inactivity inquiries are once more circulating rather freely, and actual sales are larger and more numerous than for a considerable time. While the volume of trade passing is still much below what could be desired,

and purchases are still largely confined to parcels for early delivery, customers being unwilling to enter into anything like extensive commitments ahead until the trend of values becomes more apparent, recent events have strengthened belief in gradual trade revival over the autumn months. Restricted production of pig iron has for long been more than ample to meet current needs, and accumulations at makers' yards have become of embarrassing dimensions, but now output promises to be absorbed, and, indeed, stocks may have to be drawn upon in the near future. Local consumption promises to increase, and expansion of demand from other home consuming centres is expected, but there seems no likelihood of early material increase in overseas trade. Ironmasters continue to offer Cleveland iron to firms in Scotland at specially low rates to compete with sellers of Indian and other iron, but refuse to extend price concessions to customers in this district, who express much dissatisfaction at having to pay substantially higher figures than are charged to buyers across the Tweed. No. 1 Cleveland iron is 61s.; No. 3 G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d.; and No. 4 forge, 57s.

**Hematite Pig Iron.**

The downward tendency in values of East Coast hematite pig iron has been checked. For long sales have been impossible except on altogether unremunerative terms, but while contracts are still unobtainable, except at prices below cost, the opinion is gaining ground that quotations have touched bottom, though producers are encumbered by heavy stocks and output is to be increased by the re-kindling of two idle furnaces. Merchants hold fairly large parcels of hematite, but are not disposed to undersell makers to any extent. Mixed numbers are quoted at 60s. and No. 1 quality at 60s. 6d.

**Ironmaking Materials.**

There is no new feature in the foreign ore trade. Dealers are not pressing sales at present prices, which are based nominally on best Rubio at 14s. 6d. c.i.f. Tees. Blast-furnace coke is plentiful. Good medium qualities keep at 14s. 6d. delivered at the works.

**Manufactured Iron and Steel.**

Quotations for semi-finished and finished iron and steel are steadily upheld, though new contracts for most descriptions of material are much needed. A few orders have been secured recently, chiefly for bridge building material. Sales of shipbuilding requisites are quite trifling, and demand for railway material is only moderate.

**The Coal Trade.**

The dullest season of the year in the coal trade is drawing to a close, and although September prospects are not easy to gauge, producers fully hope to improve on the recent average of business. Most of the collieries are looking forward to more home trade and to some expansion in exports, although openings in the latter connection are restricted in many directions. There is not nearly enough trade, however, to keep collieries working regularly, and pits continue to lose whole weeks at a time. Poland continues a formidable rival for Scandinavian coal orders. Her prices are under the minimum figures for Northumberland and Durham, and therefore it is not surprising that they attract business. The quality of the coal is good and thus the price factor is all important. The Norwegian State Railways' contract for 10,000 tons of steam coals, for which tenders were sent from this area, has gone to Poland at 12s. 7½d. per ton f.o.b. Danzig or Gdynia. Comparable Northumberland coal is 13s. 6d. There is only a moderate demand for early shipment in the Northumberland steam coal trade, but collieries are fairly comfortably booked over the next two or three weeks, and, although offering additional supplies freely, are quoting more steadily. Best large are quoted at 13s. 6d., and small, being in short supply, are firm at 8s. 6d. Prime Wear large continues steady at 15s. to 15s. 1½d., with small at 11s. to 11s. 1½d. Tyne primes are a quiet section at 12s. 9d. and 9s. for large and small respectively. There is little movement in the Durham trade generally. Bunker coal demand is fairly well sustained, but prices hold just steady under ample supplies, and buyers can readily secure any class. Best qualities are quoted at 13s. 6d. to 13s. 9d., and ordinary at 13s. Gas coal is a dull trade at 14s. 6d. for best and 13s. to 13s. 6d. for second qualities. Gas coke continues to meet a brisk inquiry, and substantial business has been booked in recent weeks. Stocks now offering for winter months' shipment are meagre, with makers holding firmly at 17s. for best sorts. Patent oven coke is quiet, but steady in tone at 14s. to 14s. 6d., and for superior makes at 15s. 6d. to 16s.

## SCOTLAND.

*(From our own Correspondent.)*

**The Trade Position.**

On the whole, there is not much change in the steel, iron, and coal trades in Scotland. With makers of heavy steel depending to a large extent on shipbuilding materials and export orders, the outlook in this industry is still rather obscure. There is, however, a better feeling apparent owing to expectations as a result of the Ottawa Conference. The increased preferences to be given to British iron and steel products may have a stimulating effect on most branches and ultimately be beneficial to the heavy departments also.

**Steel.**

The restriction of specifications has already been referred to in relation to shipyard requirements, but it might also be said that structural steel also is not so well specified as formerly. Steel sheets have a fair turnover and, in fact, provide the brightest spot in the industry at present. The usual seasonal demands from Canada and the East are about due, and the position is more favourable. Galvanised sheets, however, are rather quiet. The inquiry for tubes has improved, but recent experience has proved that consumers are acting with great caution and that actual buying has been reduced to a minimum, especially perhaps in the case of oil-producing concerns.

**Iron.**

The reduced requirements of rivet and bolt works, tube makers, wagon builders, &c., continue to have a severe effect on the output from the bar iron works. Re-rollers, too, are not particularly well employed, orders as a rule being for very moderate quantities. Bar iron is unchanged in price, with re-rolled steel bars quoted £6 10s. home (fixed) and £6 5s. per ton export.

**Pig Iron.**

The production of pig iron in Scotland is still represented by the output from one furnace. Tariffs may have practically eliminated the import of Continental material, but this is offset to a considerable extent by the flow of material from Calcutta and, to a lesser degree, from England. During the past week 1750 tons arrived from Calcutta and 430 tons from Barrow. Consequently home producers are not receiving much, if any, benefit from the protection against Continental iron.

**Scrap.**

Prices of scrap are still inclined to sag and heavy smelting steel can be bought round about 35s. per ton and cast iron machinery scrap 44s. 6d. per ton.

**Coal.**

Export demands for coal are fair, though mostly confined to small quantities for immediate or early shipment. Supplies, however, in the case of large coal are plentiful, owing in a measure to the scarcity of orders in the home market. Fifeshire and Lothians steams move freely, but Lanarkshire steams, ells and splints are rather slow. The strength of the market is to be found in washed nuts, especially trebles and doubles. Aggregate shipments amounted to 224,401 tons, against 220,224 in the preceding week and 213,493 tons in the same week last year. Prices as a rule show no change.

**Coal Cutting.**

The amount of mechanically cut coal has been on the increase since the year 1913, the number of cutters employed having risen from 876 to 1522 in 1931, and the percentage of cut fuel rising from 21·68 to 66 per cent. There are actually more cutters installed in Scottish collieries, but the number quoted represents those in operation during 1931.

**Pit Ponies.**

In Scotland pit ponies are gradually being replaced by the electric motor. In 1913 over 5000 ponies were working underground, and this number had fallen to 1400 in 1931, though it must be remembered that a number of pits are non-operative at present.

## WALES AND ADJOINING COUNTIES.

*(From our own Correspondent.)*

**The Coal Trade.**

SHIPMENTS of coal and coke from this district last week were not at all good, and after the recent improvement the figures prove a disappointment. According to the G.W.R. Company's returns, the total for the whole of the leading ports was only 337,040 tons, as compared with 398,750 tons for the preceding week and with 468,608 tons for the corresponding period of last year. Unquestionably, the decline was mainly attributable to the reduced shipments of steam coals. The position at the end of last week showed that the docks were not at all well supplied with tonnage, as there were as many as forty vacant berths at the ports between Newport and Port Talbot, while at Swansea the loading activity was not quite so pronounced, as there were three vacant berths at this port, although one steamer was waiting to load. Still, this was only a temporary easing off so far as Swansea was concerned, as this week opened with all berths being occupied and two steamers waiting to load. At the steam coal ports, however, despite week-end arrivals, there were no less than twenty-seven idle tips, and unfortunately, the volume of chartering of late has not been by any means active. New business to come along has been meagre in the extreme. Out of a total quantity of 20,000 tons of locomotive coals required by the Norwegian State Railways only one cargo of 2500 tons has been placed with a Cardiff firm of coal exporters. Still, it was expected that the bulk of this order would go to competitors. Now that the Ottawa Conference is over it is hoped that the Government will turn their attention more to coal trade affairs as they affect this country and near Continental countries, in view of reports concerning fresh agreements. It can, however, be stated that so far as the recent report is concerned that the import quota of Polish coals into France was to be increased from 40,000 tons to 100,000 tons monthly, the South Wales Coal Exporters' Association has learned officially that this is incorrect, as no agreement to this effect has been signed. As regards the Belgian-German provisional agreement whereby the coal import quota is to be reduced from 55 to 45 per cent., subject to certain compensations to be arranged later, fears of coalowners and exporters in this country have to some extent been allayed by the unofficial announcement that the British Government and representatives of the coalowners and exporters are very closely watching the position in Belgium, and that decisions have already been taken on lines which it is hoped will protect to the utmost extent British interests. There is apparently to be no variation in the import quota for British coals into France for the month of September. No official news has yet been issued regarding the new Coalowners' Association recently formed for the purpose of preventing underselling of steam and bituminous coals in this area; but it is fully expected that more will shortly be known about the scope of this organisation, in view of the fact that it is reported that the scheme is to come into operation at the end of September. Its early introduction is evidently contemplated, as it is understood that rooms have already been taken in one of the leading buildings at the Cardiff Docks for the accommodation of the auditors and staff, and that a member of the staff of a leading firm of accountants has been appointed secretary.

**Cardiff's Import Trade.**

In view of the fact that legislation is now promised for a modification of the conditions governing the importation of cattle into the United Kingdom from Canada, Cardiff is looking forward to a revival of its import trade in this line, more especially as Cardiff is the only port in South Wales and one of the few in this country licensed for the importation of cattle from abroad. Furthermore, the equipment provided by the Great Western Railway Company is up to date, as a special berth adjoins the lairs for the landing of the cattle, and there is accommodation for 900 store or 500 fat cattle besides accommodation for sheep and pigs.

**Removal Rumour Denied.**

The manager of the Landore Works denies that there is any truth in the report which was current in the Swansea district at the end of last week that the British Mannesmann Company was closing down its works at Landore with the intention of concentrating the whole of its South Wales operations at Newport.

**Milford Haven's Water Enterprise.**

On Thursday in last week Milford Haven's £100,000 water undertaking was officially opened. The ceremony took place at the reservoir at the foot of the Precelly Mountains, 19 miles from the port of Milford Haven. The ceremony was performed by Major Gwilym Lloyd George, M.P. The pipe line contractors were the South Wales Contractors, Ltd., of Swansea.

**North Wales Coalfield.**

There is to be a conference at Llandudno shortly, called by the Mayor of Wrexham, to consider the situation of the coal industry of North Wales. Invitations have been sent to seventy-seven local authorities to attend. The Mayor appeals to them to give North Wales coal first consideration, and so enable the collieries to continue working. He points out that at present the mineworkers are only working about three or four days a week.

**Newport Flying Club.**

Two years ago the question of a municipal aerodrome was considered by the Newport Town Council, land was surveyed and plans prepared, but the matter was shelved. Now there is a movement on foot at Newport to form a flying club, and it is expected that this will receive the sympathetic consideration of the majority of the members of the Corporation.

**Current Business.**

Conditions on the steam coal market show no new feature. Most descriptions are in excessive supply, an exception being dry sized qualities, which are scarce and firm, and command 6d. to 9d. per ton above minima prices. Anthracite coals are firm all round. Patent fuel continues to be well stemmed, and the inquiry for coke is a shade better. Pitwood is coming along more freely and prices are easier at 21s. 6d. to 22s. 6d.

## PERSONAL AND BUSINESS ANNOUNCEMENTS.

J. H. HUMPHREYS AND SONS will remove on September 6th to Blackriding Electrical Works, Werneth, Oldham.

BASTIAN AND ALLEN, Ltd., have removed to 12 and 14, Church-road, Hanwell, London, W.7; Ealing 6733-4-5.

MR. WILLIAM JOHNSTONE MARSHALL, M.I. Mech. E., late of Agricultural and General Engineers and Richard Garrett and Sons, Ltd., has joined the organisation of Ransomes and Rapier, Ltd.

DAVIDSON AND CO., Ltd., Sirocco Engineering Works, Belfast, has acquired the fan patents and Trade Mark rights of Aeroto Ltd., formerly of Bush House, London, W.C.2, and Letchworth, Herts.

MR. ALAN WILLIAMS, of Messrs. Wolf and Williams, 53, Victoria-street, Westminster, S.W.1 (telephone Victoria 6051), is now acting as local agent for the Wills pressure filled joint rings, which were described in our issue of August 19th, 1932.

COWANS, SHELDON AND CO., Ltd., of Carlisle, announce that they have recently opened an office at Bush House, Aldwych, W.C. 2.—telephone, Temple Bar 7851—which will be under the management of Mr. J. W. Branston, a director of the company.

MR. CHARLES S. PARSONS, B.Sc., C.P.A., C.Inst.E.E., is now released from his partnership engagement with Forrester, Ketley and Co., and will in future carry on practice under his own name as a chartered patent agent and consulting engineer at Thanet House, 231, Strand, W.C.2.

A. C. WICKMAN, Ltd., machine tool specialists, Coventry, have been appointed agents in Great Britain and Ireland for Birmingham Electric Furnaces, Ltd., manufacturers of "Birlec" furnaces, who recently entered into agreements with the Electric Furnace Company, Salem, Ohio, U.S.A., and C. I. Hayes Inc., Rhode Island, U.S.A., for the fullest exchange of information and designs.

WEEKLY WEATHER REPORT.—The fourth volume of the new series of Weather Reports has just been issued by the Meteorological Office for the Air Ministry. Weekly mean values of temperature, rainfall and sunshine, with deviations from normal, are given for the period March 1st, 1931, to February 27th, 1932, for fifty-seven stations well distributed over the British Isles. A single page shows the weekly values for the whole year for a single station, an arrangement which allows the general course of the weather at a particular place to be ascertained very quickly. Another table shows weekly and seasonal means of the same elements for each of the twelve districts into which the country is divided. It was found necessary to substitute Kirkwall for Deerness, Renfrew for Kilmarnock, and Newton Rigg for Aspatria, but, apart from this, the report closely resembles the report for the preceding year. It can be purchased from H.M. Stationery Offices, price 15s. net.

# Current Prices for Metals and Fuels.

## IRON ORE.

| | |
|---|---|
| N.W. COAST— | |
| (1) Native | 16/6 to 20/- |
| (1) Spanish | 17/- to 22/6 |
| N.E. COAST— | |
| Native | 16/- to 21/- |
| Foreign (c.i.f.) | 14/6 |

## PIG IRON.

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| (2) SCOTLAND— | | |
| Hematite | 3 8 6 | — |
| No. 1 Foundry | 3 12 0 | — |
| No. 3 Foundry | 3 9 6 | — |
| N.E. COAST— | | |
| Hematite Mixed Nos. | 3 0 0 | 3 0 0 |
| No. 1 | 3 0 6 | 3 0 6 |
| Cleveland— | | |
| No. 1 | 3 1 0 | 3 1 0 |
| Siliceous Iron | 3 1 0 | 3 1 0 |
| No. 3 G.M.B. | 2 18 6 | 2 18 6 |
| No. 4 Foundry | 2 17 6 | 2 17 6 |
| No. 4 Forge | 2 17 0 | 2 17 0 |
| Mottled | 2 16 6 | 2 16 6 |
| White | 2 16 6 | 2 16 6 |
| MIDLANDS— | | |
| (c) Staffs.— | (*Delivered to Station*). | |
| All-mine (Cold Blast) | — | — |
| North Staffs. Forge | 3 1 0 | — |
| „ „ Foundry | 3 6 0 | — |
| (c) Northampton— | | |
| Foundry No. 3 | 3 2 6 | — |
| Forge | 2 17 6 | — |
| (c) Derbyshire— | | |
| No. 3 Foundry | 3 6 0 | — |
| Forge | 3 1 0 | — |
| (3) Lincolnshire— | | |
| No. 3 Foundry | — | — |
| No. 4 Forge | — | — |
| Basic | — | — |
| (4) N.W. COAST— | | |
| N. Lancs. and Cum.— | | |
| Hematite Mixed Nos. | 3 15 6 (a) | — |
| | 4 0 6 (b) | — |
| | 4 5 6 (c) | — |

## MANUFACTURED IRON.

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| SCOTLAND— | | |
| Crown Bars | 9 15 0 | 9 5 0 |
| Best | — | — |
| N.E. COAST— | | |
| Iron Rivets | 11 5 0 | — |
| Common Bars | 9 5 0 | — |
| Best Bars | 10 5 0 | — |
| Double Best Bars | 10 15 0 | — |
| Treble Best Bars | 11 5 0 | — |
| LANCS.— | | |
| Crown Bars | 9 15 0 | — |
| Best Bars | 10 5 0 | — |
| Hoops | 12 0 0 | — |
| S. YORKS.— | | |
| Crown Bars | 9 15 0 | — |
| Best Bars | 10 15 0 | — |
| Hoops | 12 0 0 | — |
| MIDLANDS— | | |
| Crown Bars | 9 0 0 to 9 15 0 | — |
| Marked Bars (Staffs.) | 12 0 0 | — |
| Nut and Bolt Bars | 8 0 0 to 8 10 0 | — |
| Gas Tube Strip | 10 10 0 | — |

## STEEL. (*d*)

| | (6) Home. £ s. d. | (7) Export. £ s. d. |
|---|---|---|
| (5) SCOTLAND— | | |
| Boiler Plates (Marine) | 9 0 0 | 8 10 0 |
| „ „ (Land) | — | — |
| Ship Plates, ½in. and up | 8 15 0 | 7 15 0 |
| Sections | 8 7 6 | 7 7 6 |
| Steel Sheets, ¼in. | 7 15 0 | 7 15 0 |
| Sheets (Gal. Cor. 24 B.G.) | 11 0 0 | 9 10 0 |

## STEEL (*continued*).

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| N.E. COAST— | | |
| Ship Plates | 8 15 0 | 7 15 0 |
| Angles | 8 7 6 | 7 7 6 |
| Boiler Plates (Marine) | 10 10 0 | — |
| „ „ (Land) | 10 0 0 | — |
| Joists | 8 15 0 | 7 7 6 |
| Heavy Rails | 8 10 0 | — |
| Fish-plates | 12 0 0 | — |
| Channels | 10 5 0 | £9 to £9 5s. |
| Hard Billets | 7 2 6 | — |
| Soft Billets | 5 10 0 | — |
| N.W. COAST— | | |
| BARROW— | | |
| Heavy Rails | 8 5 0 | — |
| Light Rails | 8 10 0 to 8 15 0 | — |
| Billets | 6 10 0 to 9 0 0 | — |
| MANCHESTER— | | |
| Bars (Round) | 9 7 6 | — |
| „ (Small Round) | 6 15 0 to 7 0 0 | — |
| Hoops (Baling) | 10 0 0 | 9 15 0 |
| „ (Soft Steel) | 9 0 0 | 8 15 0 |
| Plates | 8 17 6 to 9 2 6 | — |
| „ (Lancs. Boiler) | 8 10 0 to 8 12 6 | — |
| SHEFFIELD— | | |
| Siemens Acid Billets | 9 2 6 (basis) | — |
| Hard Basic | 8 2 6 and 8 12 6 | — |
| Intermediate Basic | 6 12 6 and 7 2 6 | — |
| Soft Basic | 5 15 0 | — |
| Hoops | 9 10 0 to 9 15 0 | — |
| Soft Wire Rods | 7 10 0 | — |
| MIDLANDS— | | |
| Small Rolled Bars (all British) | 7 0 0 to 7 5 0 | — |
| Small Re-rolled Bars | 6 7 6 to 6 10 0 | — |
| Billets and Sheet Bars | 4 17 6 to 5 7 6 | — |
| Galv. Sheets, f.o.b. L'pool | 9 2 6 to 9 7 6 | — |
| (2) Staffordshire Hoops | 9 10 0 | — |
| (d) Angles | 8 7 6 | — |
| (d) Joists | 8 15 0 | — |
| (d) Tees | 9 7 6 | — |
| (d) Bridge and Tank Plates | 8 17 6 | — |
| Boiler Plates | 8 7 6 to 8 10 0 | — |

## NON-FERROUS METALS.

| | | |
|---|---|---|
| SWANSEA— | | |
| Tin-plates, I.C., 20 by 14 | f.o.b. | 15/0 to 15/6 |
| Block Tin (cash) | | 149 15 0 |
| „ (three months) | | 150 15 0 |
| Copper (cash) | | 35 15 0 |
| „ (three months) | | 35 10 0 |
| Spanish Lead (cash) | | 13 2 6 |
| „ „ (three months) | | 13 2 6 |
| Spelter (cash) | | 14 10 0 |
| „ (three months) | | 14 16 3 |
| MANCHESTER— | | |
| Copper, Best Selected Ingots | | 38 10 0 |
| „ Electrolytic | | 38 0 0 |
| „ Strong Sheets | | 62 0 0 |
| „ Tubes (Basis Price), lb. | | 0 0 10 |
| Brass Tubes (Basis Price), lb. | | 0 0 9 |
| „ Condenser, lb. | | 0 0 11½ |
| Lead, English | | 15 5 0 |
| „ Foreign | | 13 10 0 |
| Spelter | | 14 17 6 |
| Aluminium (per ton—raw ingot) | £95 | |

## FERRO ALLOYS.

| | Per Ton. | Per Unit. |
|---|---|---|
| Tungsten Metal Powder | 2/- per lb. | |
| Ferro Tungsten | 1/9 per lb. | |
| Ferro Chrome, 4 p.c to 6 p.c. carbon | £25 0 0 | 8/- |
| „ „ 6 p.c. to 8 p.c. | £24 10 0 | 7/6 |
| „ „ 8 p.c. to 10 p.c. | £23 15 0 | 7/- |
| „ „ Specially Refined | | |
| „ „ Max. 2 p.c. carbon | £37 0 0 | 11/- |
| „ „ „ 1 p.c. carbon | £47 0 0 | 14/- |
| „ „ „ 0·70 p.c. carbon | £48 0 0 | 16/- |
| „ „ „ carbon free | 1/1 per lb. | |
| Metallic Chromium | 2/9 per lb. | |
| Ferro Manganese (per ton) | £11 0 0 for home | |
| „ „ „ | £11 10 0 for export | |
| „ Silicon, 45 p.c. to 50 p.c. | £13 10 0 scale 5/- per unit | |
| „ „ 75 p.c. | £19 0 0 scale 6/- per unit | |
| „ Vanadium | 12/6 per lb. | |
| „ Molybdenum | 6/3 per lb. | |
| „ Titanium (carbon free) | 9d. per lb. | |
| Nickel (per ton) | £250 to £255 | |
| Ferro Cobalt | 6/- per lb. | |

## FUELS.

### SCOTLAND.

| | Export. |
|---|---|
| LANARKSHIRE— | |
| (f.o.b. Glasgow)—Steam | 13/- |
| „ „ Ell | 14/- |
| „ „ Splint | 13/9 to 14/9 |
| „ „ Trebles | 13/- to 13/6 |
| „ „ Doubles | 11/6 |
| „ „ Singles | 10/- |
| AYRSHIRE— | |
| (f.o.b. Ports)—Steam | 11/6 |
| „ „ Jewel | 16/6 |
| „ „ Trebles | 13/6 |
| FIFESHIRE— | |
| (f.o.b. Methil or Burntisland)—Steam | 10/3 to 12/6 |
| Screened Navigation | 16/6 |
| Trebles | 14/6 to 15/6 |
| Doubles | 12/- |
| Singles | 10/- |
| LOTHIANS— | |
| (f.o.b. Leith)—Best Steam | 11/- to 11/6 |
| Secondary Steam | 10/6 |
| Trebles | 14/- |
| Doubles | 11/6 |
| Singles | 9/9 to 10/- |

### ENGLAND.

| | |
|---|---|
| (8) N.W. COAST— | |
| Steams | 21/- |
| Household | 32/6 to 51/8 |
| Coke | 19/- to 22/6 |
| NORTHUMBERLAND— | |
| Best Steams | 13/6 |
| Second Steams | 12/3 to 12/6 |
| Steam Smalls | 8/6 |
| Unscreened | 12/6 to 13/- |
| Household | 27/- to 39/- |
| DURHAM— | |
| Best Gas | 14/6 |
| Second | 13/3 to 13/6 |
| Household | 25/- to 37/- |
| Foundry Coke | 24/- |

| SHEFFIELD— | Inland. | |
|---|---|---|
| Best Hand-picked Branch | 25/- to 26/- | — |
| South Yorkshire Best | 20/- to 21/- | — |
| Derbyshire Best House | 20/- to 21/- | — |
| Derbyshire Best Brights | 17/- to 18/- | — |
| Screened House Coal | 15/- to 16/- | — |
| Kitchen Coal | 14/- to 15/6 | — |
| Best Screened Nuts | 15/- to 16/- | — |
| Small Screened Nuts | 13/6 to 15/6 | — |
| Yorkshire Hards | 16/- to 18/- | — |
| Derbyshire Hards | 16/- to 16/- | — |
| Rough Slacks | 8/6 to 9/6 | — |
| Nutty Slacks | 7/- to 8/6 | — |
| Blast-furnace Coke (Inland) | 9/6 to 9/9 on rail at ovens | |
| Furnace and Foundry Coke (Export), f.o.b., 13/6 to 15/6 | | |

### (9) SOUTH WALES.

| CARDIFF— | |
|---|---|
| Steam Coals: | |
| Best Smokeless Large | 19/6 to 19/9 |
| Second Smokeless Large | 18/9 to 19/6 |
| Best Dry Large | 19/- to 19/6 |
| Ordinary Dry Large | 17/9 to 18/3 |
| Best Black Vein Large | 18/3 to 18/6 |
| Western Valley Large | 17/9 to 18/- |
| Best Eastern Valley Large | 17/7½ to 17/9 |
| Ordinary Eastern Valley Large | 17/3 to 17/6 |
| Best Steam Smalls | 13/- to 13/6 |
| Ordinary Smalls | 11/- to 13/- |
| Washed Nuts | 19/- to 25/- |
| No. 3 Rhondda Large | 19/6 to 19/9 |
| „ „ Smalls | 15/- to 16/- |
| No. 2 „ Large | 17/- to 17/3 |
| „ „ Through | 16/6 to 16/- |
| „ „ Smalls | 14/- to 14/3 |
| Foundry Coke (Export) | 22/6 to 36/6 |
| Furnace Coke (Export) | 17/- to 18/- |
| Patent Fuel | 20/- |
| Pitwood (ex ship) | 21/- to 22/6 |
| SWANSEA— | |
| Anthracite Coals: | |
| Best Big Vein Large | 36/- to 38/6 |
| Seconds | 27/- to 32/6 |
| Red Vein | 22/6 to 27/6 |
| Machine-made Cobbles | 41/6 to 43/6 |
| Nuts | 40/- to 43/6 |
| Beans | 28/6 to 32/6 |
| Peas | 19/6 to 21/- |
| Breaker Duff | 8/6 to 9/6 |
| Rubbly Culm | 11/- to 11/9 |
| Steam Coals: | |
| Large | 20/- to 20/6 |
| Seconds | 18/- to 20/- |
| Smalls | 11/6 to 13/- |
| Cargo Through | 16/- to 17/6 |

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate: Joists (minimum), 22/6: Ordinary Ship, Bridge, and Tank Plates and Sections, 15/- if home consumers confine purchases from associated British Steel Makers. (e) Delivered Black Country Stations.

# French Engineering Notes.

*(From our own Correspondent in Paris.)*

### Trade Agreements.

THE iron, steel and engineering trades appear to have reached the bottom of the downward curve and are now stationary at a level of poor activity and low prices. It is not expected that the situation will become worse so long as the State is able to provide a certain amount of work, though it is feared that orders from this source will become scarce in view of the necessity of carrying out further economies in national expenditure. The railway companies are buying little and private enterprise is very restricted, so that makers can only look for recovery to trade agreements which may help to encourage commercial activity and create some confidence. The first negotiations started this week with the United States under conditions that, unfortunately, do not seem promising, for official statements make it clear that the rigid American tariff system will not allow of the States offering concessions for the advantages they are claiming from France. The French affirm that their manufacturing industries must not be sacrificed, and there is a fear that they will be seriously affected by a heavy importation of manufactured goods, particularly in view of the increasing production costs in this country. The negotiations for treaties of commerce with the United States and Great Britain seem likely to be long and arduous.

### Steel Consumption.

Steel is being more largely employed as a building material and its consumption is relatively greater than during the period when reinforced concrete appeared likely to supersede metallic construction. There is now little building in Paris and elsewhere, but what is being done is mostly of steel. During the earlier part of the past decade reinforced concrete seemed to offer advantages in the way of rapid and cheap erection, and a vast amount of building was undertaken with this material, without any consideration as to whether it would meet the public requirements. Reinforced concrete dwelling-houses are not popular and are not easy to let. Steel-frame construction is now cheaper, and while supplies of steel are obtainable at low prices makers are producing lighter sections of higher resistance metal. The preference shown for steel-frame buildings by those who have to live in them has permanently checked the progress of reinforced concrete for that particular application, and for general constructional work the Office National pour l'Utilisation de l'Acier continues to carry on an active propaganda in favour of steel by demonstrating the economy, safety, and convenience of that metal.

### African Air Service.

The creation of an air service between Brussels and the Congo was decided upon three years ago, when France and Belgium signed an agreement for working in collaboration a route across the Sahara Desert from Algiers to the Niger, and that line would be extended by France from the Belgian Congo to Mozambique and thence to Madagascar, while eventually another line would be run from Mozambique to the Cape. An arrangement was come to with Portugal for the use of Mozambique as an air base. The service was to have been started on October 1st next. Two companies were formed to exploit the service with State participation and under State control—the Belgian Sabena and the French Sadan. The Belgians are now prepared to carry out their part of the programme, but the French company has failed to obtain the necessary financial assistance from the Government, which is unable to provide funds for a costly development undertaking when national finances require the exercise of rigid economy. Moreover, it is by no means certain that a public air service can be run with perfect safety across the Sahara Desert without an organisation offering difficulties and involving great expense. As the Belgians cannot take advantage of this direct route it is reported that they intend to start their service to the Congo at the beginning of October by following the coast of Spain and the West Coast of Africa. The situation is causing some uneasiness in France because the convention with Portugal will presumably become invalid through failure to fulfil its obligations within the stipulated time, and if, as is reported, foreign interests aim at creating an air service between St. Paul de Loanda and Mozambique, difficulties may arise in the way of organising the French line to Madagascar.

### Alcohol Fuel.

The use of alcohol as a fuel for internal combustion engines is regarded as of the first importance as a means of reducing expenditure on imported oils and of opening up a practically unlimited consumption for all the alcohol that can be produced by the agricultural industry. The purchase and sale of beet alcohol is a State monopoly, which must find a means of disposing of increasingly unwieldy stocks. The Office National de Combustibles Liquides claims that all technical difficulties in the way of using alcohol in internal combustion engines have been overcome by a mixture of 25 per cent. of that spirit with petrol, and that it offers certain advantages, notably in preventing pre-detonation or "knocking." In July of last year the Government was induced to publish a decree enforcing the use of this mixture for public service and commercial vehicles, but the decree did not become effective until the following November, when it was found that in winter the alcohol-petrol mixture was not conducive to the easy starting of engines. As was the case in all previous attempts to render the use of alcohol compulsory, the decree simply became inoperative because no one would employ the spirit. The Commission des Mines et de la Force Motrice argues that the experiment last year would have had a much better chance of success if commercial vehicle owners had been obliged to use the petrol-alcohol mixture during the summer, when they would have learned to adjust their engines and avoid the difficulty of starting in cold weather. It therefore urges the Government to issue immediately a new decree so that the necessary experience may be gained during the summer months.

# British Patent Specifications.

*When an invention is communicated from abroad the name and address of the communicator are printed in italics.*

*When an abridgment is not illustrated the Specification is without drawings.*

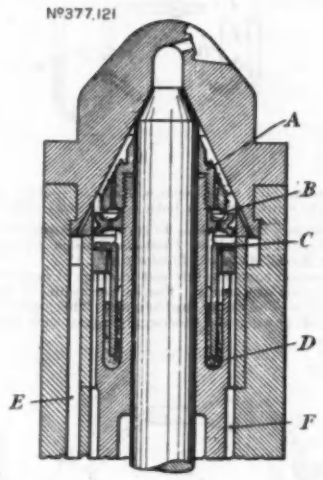
*Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.*

*The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.*

## INTERNAL COMBUSTION ENGINES.

377,121. February 12th, 1932.—FUEL INJECTION VALVES, H. Dinner, Ennenda, Glarus, Switzerland.

This is a rather elaborate valve and is described in detail. It is of the air injection type and, in essence, the idea is to prevent a puff of compressed air entering the combustion space in advance of the fuel and thus cooling the charge. A series of

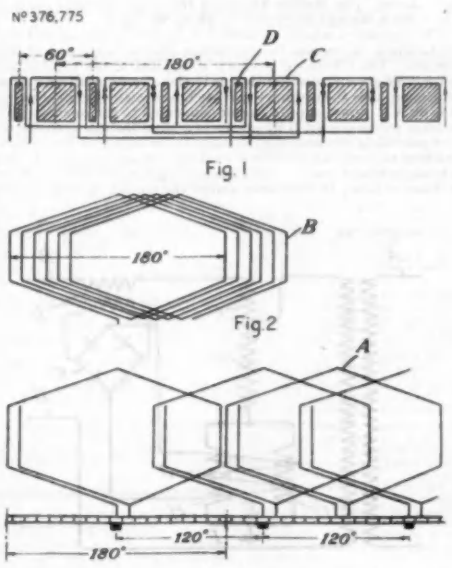



traps is arranged round the head of the valve guide, as shown at A, B, C and D, which accumulate fuel oil supplied at E. When the valve opens compressed air, from F, picks up this oil successively from the various traps and injects it into the cylinder. The blast of air is maintained for a short period after the whole of the oil has been injected to clean the valve seating.—*July 21st*, 1932.

## DYNAMOS AND MOTORS.

376,775. April 7th, 1931.—DYNAMO-ELECTRIC MACHINES, International General Electric Company, Inc., of 120, Broadway, New York, U.S.A.

Three-phase commutator machines which are excited from the stator with low frequency are well known. They serve mainly for cascade connection with asynchronous motors and are then excited with slip frequency. The compensating winding of the Scherbius machine is very complicated, since in each pole section all the three phases must be mixed. Furthermore, for the commutating winding of the commutating poles two phases must be mixed on each commutating pole. According to the invention, a simple compensating and commutating pole winding is obtained. The armature winding A is a lap winding, with 180 deg. coil width (Fig. 3). The compensating winding B is a lap wind-

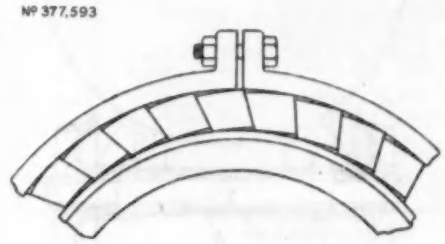



ing with a coil width of 180 deg. (Fig. 2). C is the exciting winding. Two coils situated 180 deg. apart belong to one phase (Fig. 1). D is the commutating pole winding arranged in the same way. B may also be any other three-phase current winding with a 180 deg. mean coil width. All these compensating windings for armature windings of 180 deg. coil width are well known in three-phase commutator machines with rotor excitation or with distributed stator excitation. It is a condition that $n_E$ equals $\frac{1}{2}n_a$, in which $n_E$=number of conductors in series per phase of the compensating winding; $n_a$=number of conductors in series per phase of the armature winding. In a six-phase set of brushes $n_E$ must be equal to $n_a$. The excitation can be a shunt, main current, separate excitation or a combination of these. The reversal of current is improved in comparison with a Scherbius machine of the same size, especially when using the six-brush connection. A machine constructed in accordance with the invention combines the advantages of the salient poles of the Scherbius machine and those of the simple compensating winding with 180 deg. coil width.—*July 7th*, 1932.

## TURBINE MACHINERY.

377,593. February 15th, 1932.—THE MANUFACTURE OF BLADE RINGS, Allmänna Svenska Elektriska Aktiebolaget, Västeras, Sweden.

In building up the blade rings of radial flow turbines it may be found that there is not quite enough room round the circumference to get in the last blade, and it has been the custom to




grind some of the spacers to make room, but the practice has the disadvantage that the spacing becomes uneven. The inventors overcome the difficulty by tilting the blades slightly, as shown in the drawing, when they occupy less circumferential space. They are then clamped down by a split band. It is claimed that the alteration to the inlet and outlet angles of the blades is immaterial, as it is so small.—*July 28th*, 1932.

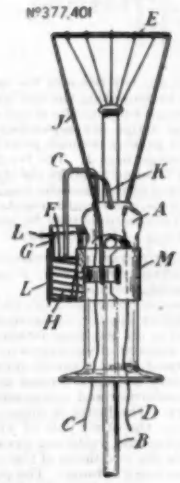
## LIGHTING AND HEATING.

377,107. January 27th, 1932. —OIL BURNERS, K. W. D. Boer, Schietbaanlaan 89A, Rotterdam, Holland.

In this open-type burner the flame can be directed to either one side or the other. The oil is contained in a V-shaped trough. The upper part of the sides of the trough are perforated and these holes direct an air blast across the surface of the oil. The air box below is divided longitudinally and each side is supplied separately with air. By adjusting the two valves, A and B, the relative strengths of the two blasts can be altered and, consequently, the direction of the flame. The valve C is for regulating the oil.—*July 21st*, 1932.

377,401. July 2nd, 1931.—ELECTRIC LAMPS, The General Electric Company, Ltd., of Magnet House, Kingsway, London, W.C.2; and Arthur George Pearce, of Research Laboratories of the General Electric Company, Ltd., Wembley.

This invention relates to electric lamps, the object being to provide an improved lamp which will be suitable for use in mines and other places where an inflammable atmosphere may be present. In the pinch A of the lamp there is an exhaust tube B and the two current leading-in wires C D. The upper end of one current leading-in wire D supports one end of the filament E. The other current leading-in wire C, however, is bent over and contacts at its end with a small metal piston F working in a cylinder G with a closed end. The piston is biassed by means of a helical spring H towards the open end of the cylinder, so that it is normally maintained in engagement with the end of the leading-in wire C. The filament support wire J, which is supported by a wire K projecting from the pinch B, is spot welded to the strap M. A small inwardly pressing V spring L enters a slit in the cylinders G against the wall of the piston F and near its upper end. During the exhaustion of the lamp after sealing of the foot assembly into the envelope the gas enclosed in the cylinder G escapes past the side of the piston F so that there is substantially no difference of pressure on the two sides of the piston and no movement of the piston away from the end of the leading-in wires C during exhaustion. Similarly there is no movement of the piston whilst the envelope is being filled with gas to the required pressure, so that after the sealing-off of the lamp and the capping the current supply to the one end of the filament E is effected by the leading-in wire D and to the other through the leading-in wire C the piston F, the cylinder G, the strap M, and the conductor J. But if the envelope of the lamp is broken there is a sudden increase of pressure on the open side of the piston F, which is consequently moved away from the end of the bent-over leading-in wire C against the pressure of the spring H before the gas has time to leak past the piston F into the closed part of the cylinder and equalise the pressure on both sides. The piston F thus breaks contact with the leading-in wire C and interrupts the supply of circuit to the filament. Eventually, of course, the gas will leak past the piston and equalise the pressure on its two sides, but the return of the piston, under the influence of the spring H, is prevented by the spring L.—*July 28th*, 1932.



## MINING MACHINERY.

377,585. February 10th, 1932.—LUBRICATING THE AXLES OF MINE TRAMS, F. Schmiad, Russtrasse 2, Teplitz-Schönau, Czechoslovakia.

The axle runs in a casing and is mounted on ball bearings. The casing is considerably larger than the axle, and the space is filled with grease through the hole A. A loose sleeve B is

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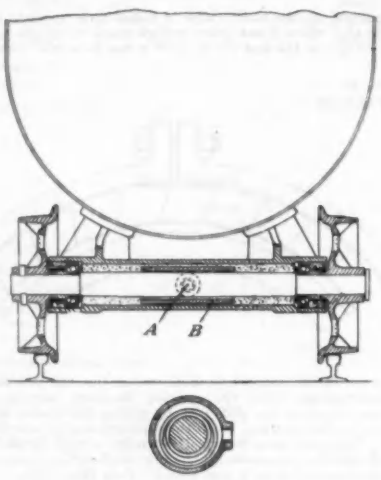


threaded on this axle. When the tub is tipped, to empty it, the axle becomes vertical, and the weight of the sleeve forces some grease into one or the other of the bearings. In order to keep the sleeve central while the tram is running, the centre of the axle is made slightly larger than the ends, so that the sleeve tends to ride up to the centre. It is said that 1·5 litres of grease is sufficient for several years' running.—*July 28th*, 1932.

## MISCELLANEOUS.

377,287. April 24th, 1931.—ELECTRIC GRID RESISTANCES, A. Reyrolle and Co., Ltd., of Hebburn-on-Tyne, Durham; and Harold Mordue, of 19, Oban-terrace, Felling-on-Tyne.

The grid resistance described in this specification is made from a sheet of metal by cutting slits A and B in it from opposite edges. Each strip thus formed between two of these slits is bent approximately along its diagonal, the bending being such that the end edges of adjacent strips are inclined in opposite directions relative to the plane of the sheet from which they are formed. This bending separates the adjacent edges of the slits, and the V thus formed may be opened out slightly at the point,

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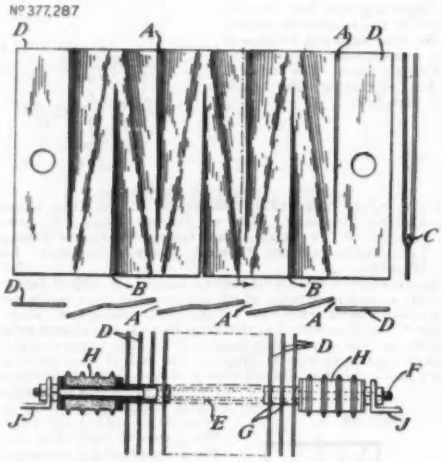


as indicated at C. The end strips D are left flat and the units are assembled to form the resistance by mounting the end strips on insulated tubes E which pass through holes in the strips and are supported on rods F. The end strips are separated by insulating distance pieces G, and after passing through porcelain insulators H the rods are secured in angle bars J. The bending of the strips in the manner described is found to make the strips so stiff that no separators are necessary other than the washers and distance pieces between the end strips, and thus the resistance is light and cheap to manufacture. Various units may be joined in series or parallel in any convenient way.—*July 25th*, 1932.

377,477. September 1st, 1931.—AUTOMATIC CONTROLLING DEVICES FOR OIL-COOLED ELECTRIC APPARATUS, Konrad Täuber, of 3, Elisenstrasse, Munich, Germany.

This invention relates to an automatic controlling device for oil-cooled electric transformers or other electric apparatus of the type depending for its operation on the fluctuations to which the oil volume is subjected on account of variations in the temperature. The oil space of the transformer A communicates through pipes B and C with a mercury switch arranged in an elevated position relative to the transformer and comprising a U-shaped tube D containing mercury. The latter is connected at E to one pole of an electric source, the other pole of which is connected, through suitable signalling and switching devices, with contacts F, G, and H arranged in the two limbs of the tube normally above the heads J of the mercury column. The pipes B and C enter and are sealed to an expansion tank K mounted above the transformer, and partly filled with oil. The pipe B opens, inside the tank, into a pipe L which forms an enlarged extension of the pipe C and which communicates with the tank through small apertures M. These apertures are so dimensioned that the normal, small fluctuations in the volume of the oil in the transformer will be compensated for by oil passing into and out of the tank through the apertures. But in the case of a detrimental rise or fall of the temperature and a corresponding excessive increase or reduction of the oil volume, the flow of liquid through the apertures is insufficient to compensate for the change in the oil volume, and there will be a change of pressure in the mercury tube D which causes the mercury column to rise in one or the other of the limbs so as to close one of the signalling or switching circuits through one of the contacts F, G, and H. Thus, since every irregularity to which the transformer is subjected brings about a change in the temperature and a consequent increase or reduction of the oil volume, if the irregularity

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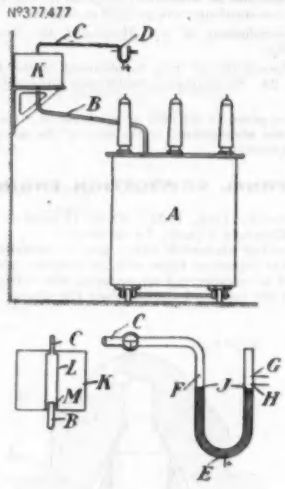


be a dangerous one, the device will either operate a signal or switch off the transformer or both.—*July 28th*, 1932.

377,573. January 26th, 1932.—FIXING SUBSTANCES TO VITREOUS ARTICLES, *The British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C.2.*

This invention concerns internal coatings of carborundum for mercury vapour arc lamps. The carborundum is fixed to the glass by means of an easily fusible glass. This glass is ground to an impalpable powder and thoroughly mixed with alcohol. The

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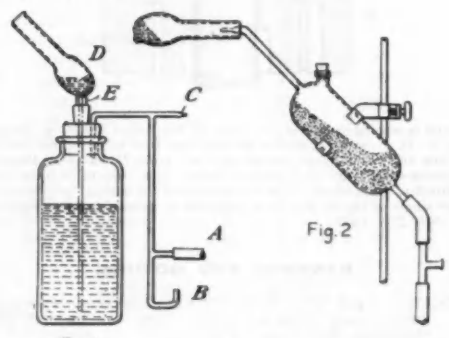


Fig. 1

Fig. 2

mixture is placed in a bottle supplied with compressed air from the hose A. B is a vent which can be closed by the finger and C a pressure relieving orifice. The lamp bulb D is pressed on the rubber stopper E and some of the liquid forced up into the bulb. It is then allowed to drain away again. While the coating left behind is still moist, carborundum is blown in by the apparatus shown in Fig. 2. The lamp is then passed through an oven to fuse the glass and is slowly cooled.—*July 28th*, 1932.

377,738. April 29th, 1931.—SYSTEMS OF ELECTRICAL REGULATION, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C.2.

The invention relates to electrical regulating means and more particularly to means for regulating the voltage of A.C. load circuits. The invention is shown as applied to the regulation of a low-voltage A.C. distribution or feeder circuit, such as a circuit which supplies the ordinary private house with electrical energy. A is an A.C. power supply circuit connected to the relatively low-voltage feeder circuit B by means of a distribution transformer. For providing the necessary voltage boost to the feeder circuit B in order to compensate for the varying voltage drops in the lines a booster transformer is used comprising a series winding C and a shunt winding D connected across the circuit B. For varying

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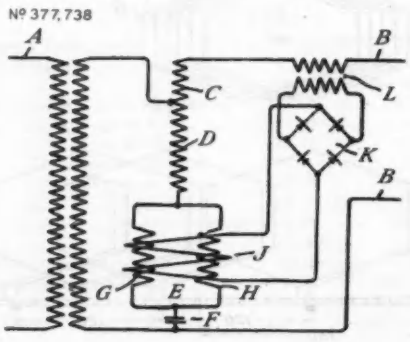


the voltage across the shunt winding D with variations in load on the circuit B in order to provide the necessary compensatory voltage boost a saturable reactor E and a capacitive reactance F are connected in series with shunt winding D. The reactor E has a pair of A.C. coils G and H, which are both linked by a D.C. saturating winding J. The coils G and H are so connected that their individual instantaneous magneto-motive forces around the magnetic circuit of the reactor are additive, while at the same time the individual instantaneous voltages induced in the D.C. saturating winding J are in opposition, and thus cancel each other. This may be readily achieved by winding the coils G and H in opposite directions with respect to saturating winding J. Such a construction not only prevents an unbalanced A.C. voltage being induced in the D.C. saturating winding, but it also prevents the production of even harmonics by the reactor. It is, of course, to be understood that in actual practice the reactor E is provided with a suitable core. For varying the current through the coil J and hence its saturating effect on the reactor with variations in load on the circuit C a full-wave copper oxide rectifier K having D.C. terminals connected to the coil J and A.C. terminals connected to a current transformer L and having its primary winding connected in the circuit B is provided.—*July 29th*, 1932.

377,859. November 2nd, 1931.—HIGH-TENSION ELECTRIC CONDENSERS, *William Warren Triggs, of the Firm of Marks and Clerk, 57 and 58, Lincoln's Inn-fields, London, W.C.2.*

According to this invention each condenser element is constructed as a wound element with a central opening. In its simplest form (Fig. 1) the condenser consists of a wound element A which is pushed with its central hole over the high-tension leading-in insulation B. The coating projecting from the lower end of the winding is conductively connected with the bolt C of

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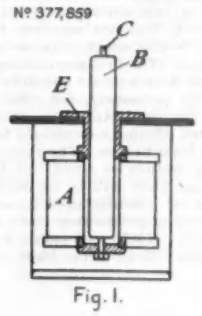


Fig. 1.

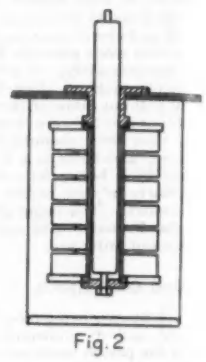

Fig. 2

the leading-in insulation carrying the high voltage, and the coating which projects at the upper end of the winding is conductively connected with the holder E of the leading-in insulator. Fig. 2 illustrates another form of construction. Instead of a single wound element A use is made of a column of similarly constructed wound elements, which are electrically connected in series with one another, this arrangement being more suitable for higher voltages. Several other arrangements are also described.—*August 4th*, 1932.

## Forthcoming Engagements.

*Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Tuesday of the week preceding the meetings. In all cases the* TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY AND SATURDAY, SEPTEMBER 3RD.

INSTITUT INTERNATIONAL DE DOCUMENTATION.—Frankfurt-am-Main. Eleventh conference. For details see page 148.

TO-DAY TO WEDNESDAY, SEPTEMBER 7TH.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—Annual meeting at York. President, Sir J. Alfred Ewing, F.R.S. Particulars may be obtained on application to the secretary, British Association, or to the hon. local secretaries, British Association, The Guildhall, York.

TO-DAY TO MONDAY, SEPTEMBER 19TH.

INSTITUTION OF MECHANICAL ENGINEERS.—Summer visit to Canada.

WEDNESDAY, SEPTEMBER 7TH.

MANCHESTER ASSOCIATION OF ENGINEERS.—Visit to the Lancashire Steel Corporation, Ltd., Irlam. Assemble at the works at 2 p.m.

SATURDAY, SEPTEMBER 10TH.

BELFAST ASSOCIATION OF ENGINEERS.—Visit to the Baun Drainage Scheme and trip to Portrush. Leave City Hall, Belfast, 1.15 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Eastern District meeting to be held at Great Yarmouth. Assemble at Town Hall, Great Yarmouth, 10.30 a.m.

MONDAY, SEPTEMBER 12TH.

INSTITUTE OF METALS.—At the Institution of Mechanical Engineers, Storey's-gate, Westminster, S.W. 1. Annual autumn lecture, "Corrosion Fatigue in Metals," by Dr. H. J. Gough. 8 p.m.

MONDAY TO THURSDAY, SEPTEMBER 12TH TO 15TH.

IRON AND STEEL INSTITUTE AND INSTITUTE OF METALS.—Joint autumn meeting in London. For programme see page 119.

TUESDAY, SEPTEMBER 13TH.

INSTITUTE OF MARINE ENGINEERS.—85, The Minories, E.C.3. Presidential Address. Commander C. W. Craven, R.N. (retd.). 6 p.m.

TUESDAY TO SATURDAY, SEPTEMBER 13TH TO 17TH.

INTERNATIONAL FOUNDRY CONGRESS.—Paris.

SATURDAY, SEPTEMBER 24TH.

ALL-BRITISH EXHIBITION.—Copenhagen, Denmark, Opening.

WEDNESDAY, SEPTEMBER 28TH.

BELFAST ASSOCIATION OF ENGINEERS.—Belfast. Inspection of new laundry, Poor Law Union. 7.30 p.m.

FRIDAY, OCTOBER 7TH.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W.1. "Cornwall as a Cradle of Science and Engineering," by Mr. S. J. Crispin. 7.30 p.m.

FRIDAY, OCTOBER 14TH.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W.1. Chairman's Address, Mr. J. Foster Petrie. 7.30 p.m.